# SOIL SURVEY OF

# Meade County, Kansas

United States Department of Agriculture
Soil Conservation Service
In cooperation with
Kansas Agricultural Experiment Station

This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in the period 1962-72. Soil names and descriptions were approved in 1973. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1973. This survey was made cooperatively by the Soil Conservation Service and the Kansas Agricultural Experiment Station. It is part of the technical assistance furnished to the Meade County Conservation District.



# HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms, ranches, and woodlands; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

## Locating Soils

All the soils of Meade County are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

## Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetic order by map symbol and shows the capability classification, range site, and windbreak suitability group in which each soil has been placed. It also shows the page where each soil is described.

Individual colored maps that show the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those that have a moderate limitation can be colored yellow, and those that have a severe limitation can be colored red.

*Farmers and those who work with farmers* can learn about use and management of the soils from the soil descriptions and from the descriptions of range sites and windbreak suitability groups.

*Foresters and others* can refer to the section "Windbreak Management," where the soils of the county are grouped according to their suitability for trees.

*Game managers, sportsmen, and others* can find information about soils and wildlife in the section "Wildlife Management."

*Ranchers and others* can find, under "Range Management," groupings of the soils according to their suitability for range and, also, the names of many of the plants that grow on each range site.

*Engineers and builders* can find, under "Engineering Uses of the Soils," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

*Scientists and others* can read about how the soils formed and how they are classified in the section "Formation and Classification of the Soils."

*Newcomers in Meade County* may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the county in the section "Environmental Factors Affecting Soil Use."

Cover: Irrigated corn and grain sorghum on Harney silt loam.

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# SOIL SURVEY OF MEADE COUNTY, KANSAS

BY BOB I. TOMASU, SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE KANSAS AGRICULTURAL EXPERIMENT STATION

MEADE COUNTY, located in the southwestern part of Kansas (fig. 1), has an area of about 626,368 acres, or 979 square miles. Meade, the county seat, is in the central part of the county.

The farm income of Meade County is derived mainly from the sale of wheat, grain sorghum, corn, alfalfa, and

all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Harney and Missler, for example, are the names of two soil series. All the soils in

While a soil survey is in progress, soil scientists take soil samples needed for laboratory measurements and for engineering tests. Laboratory data from the same kind of soil in other places are also assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kind of soil. Yields under defined management are estimated for all the soils.

Soil scientists observe how soils behave when they are used as a growing place for native and cultivated plants or as material for structures, foundations for structures, or covering for structures. They relate this behavior to properties of the soils. For example, they observe that filter fields for onsite disposal of sewage fail on a given kind of soil, and they relate this to the slow permeability of the soil or to its high water table. They see that streets, road pavements, and foundations for houses are cracked on a particular soil, and they relate this failure to the high shrink-swell potential of the soil material. Thus, they use observation and knowledge of soil properties, together with available research data, to predict limitations or suitability of soils for present and potential uses.

After data have been collected and tested for the key, or

gineers, and others. They then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under current methods of use and management.

## General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Meade County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map that shows soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area or in planning engineering works, recreational facilities,


Mansic
Crooked
Uly
Horney
Roxbury
Uly
Mansic
Uly
LOESS
Creek

This association is mostly along the west side of the Crooked Creek north of Meade. It is dominantly gently sloping to strongly sloping, but in places the sides of the valley are steep (fig. 3).

This association makes up about 8 percent of the county. It is about 34 percent Uly soils, 26 percent Mansic soils, and 40 percent minor soils.

Uly soils are well-drained, gently sloping and sloping soils. The surface layer is grayish-brown silt loam about 6 inches thick. The subsoil, about 8 inches thick, is dark grayish-brown silty clay loam. The underlying material is pale-brown silt loam.

Mansic soils are well-drained, sloping and strongly sloping soils along the drainageways that empty into Crooked Creek. The surface layer is dark grayish-brown clay loam about 17 inches thick. The subsoil, about 10 inches thick, is pale-brown clay loam. The underlying material is very pale brown clay loam.

The minor soils of this association consist of Harney, Campus, Canlon, and Roxbury soils. Harney soils are nearly level to gently sloping soils on areas between the tributaries of Crooked Creek. The closely intermingled Campus and Canlon soils are on the steeper parts of the association. Roxbury soils are nearly level on stream flood plains.

Most areas of the gently sloping and sloping soils of this association are cultivated. Wheat and grain sorghum are the main dryfarmed crops. Soil blowing and water erosion are serious hazards. Conservation of water is needed to obtain favorable yields. The strongly sloping, more broken slopes are in native grasses and used for grazing.

## 3. Roxbury-Leshara-Likes Association

*Deep, nearly level to gently sloping loamy and sandy soils on flood plains and terraces*

This soil association is on flood plains, low terraces, and alluvial fans in the valleys of the major streams throughout the county. It is nearly level to gently sloping.

This association makes up about 6 percent of the county. It is about 21 percent Roxbury soils, 19 percent Leshara soils, 19 percent Likes soils, and 41 percent minor soils.

Roxbury soils are well-drained, nearly level soils on low stream terraces. The surface layer is grayish-brown silt loam. The underlying material is very pale brown to pale-brown silty clay loam.

are the main dryfarmed crops. Wheat, corn, grain, and forage sorghum are the main irrigated crops. Most areas of the Leshara, Likes, and minor soils are used for range. The Kanza soils are also used for meadow.

## 4. Harney-Missler Association

*Deep, nearly level to sloping loamy soils of the uplands*

This soil association is on a broad area north and west of Fowler. This area is locally called the Artesian Valley because of the Artesian conditions that prevailed at one time. The association is nearly level.

This association makes up about 4 percent of the county. It is about 45 percent Harney soils, 42 percent Missler soils, and 13 percent minor soils.

Harney soils are well-drained, nearly level soils. The surface layer is grayish-brown silt loam about 6 inches thick. The subsoil, about 23 inches thick, is dark grayish-brown to brown silty clay loam in the upper part and brown to pale-brown silty clay loam in the lower part. The underlying material is light yellowish-brown silt loam.

Missler soils are well-drained, nearly level to sloping soils on broad areas and side slopes. The surface layer is grayish brown silty clay loam about 13 inches thick. The subsoil, about 11 inches thick, is grayish-brown silty clay loam. The underlying material is pale-brown silty clay loam.

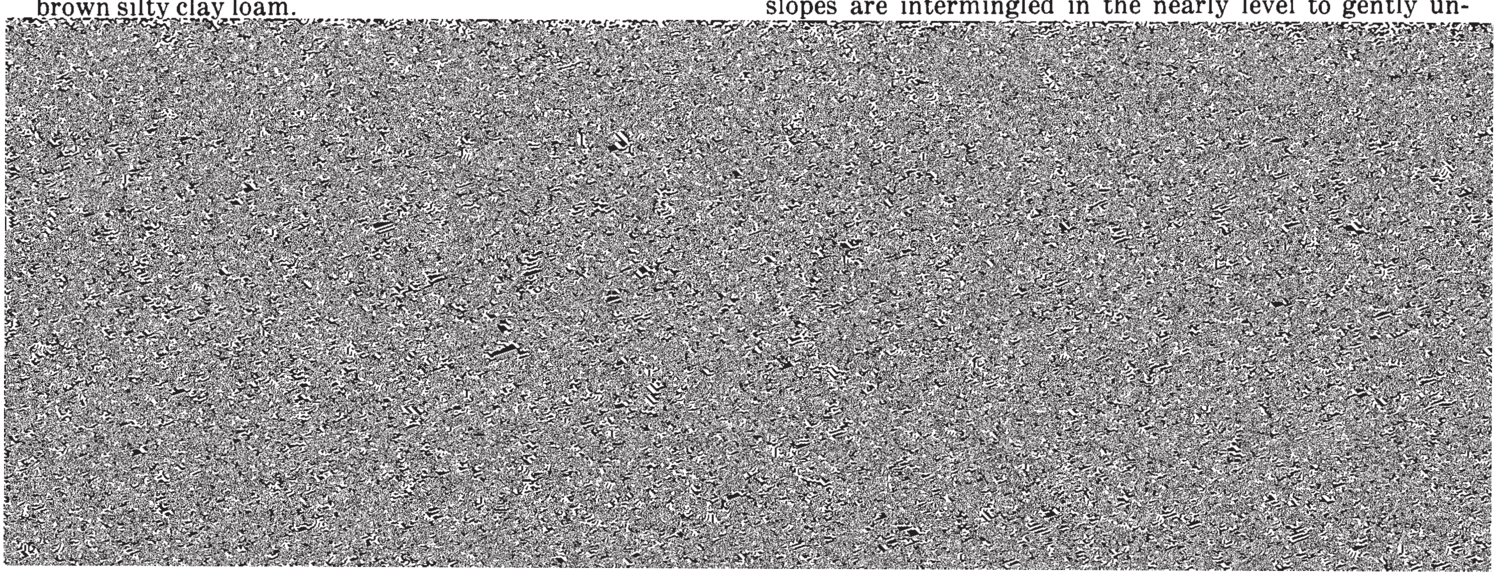
The minor soils of this association consist of Ness and Uly soils. Uly soils are gently sloping in small areas of this association, and Ness soils are in depressions.

The soils of this association are used for dryfarmed and irrigated crops. Wheat and grain sorghum are the main dryfarmed crops. Wheat, corn, alfalfa, grain, and forage sorghum are the main irrigated crops. Soil blowing is a serious hazard on the level soils, and water erosion and soil blowing are hazards on the sloping soils. Conservation of water is needed on all the soils of this association to obtain favorable yields.

## 5. Manter-Satanta Association

*Deep, nearly level to gently sloping or gently undulating loamy soils of the uplands*

This soil association is in an area between the sandhills and the nearly level tablelands. Concave and convex slopes are intermingled in the nearly level to gently un-



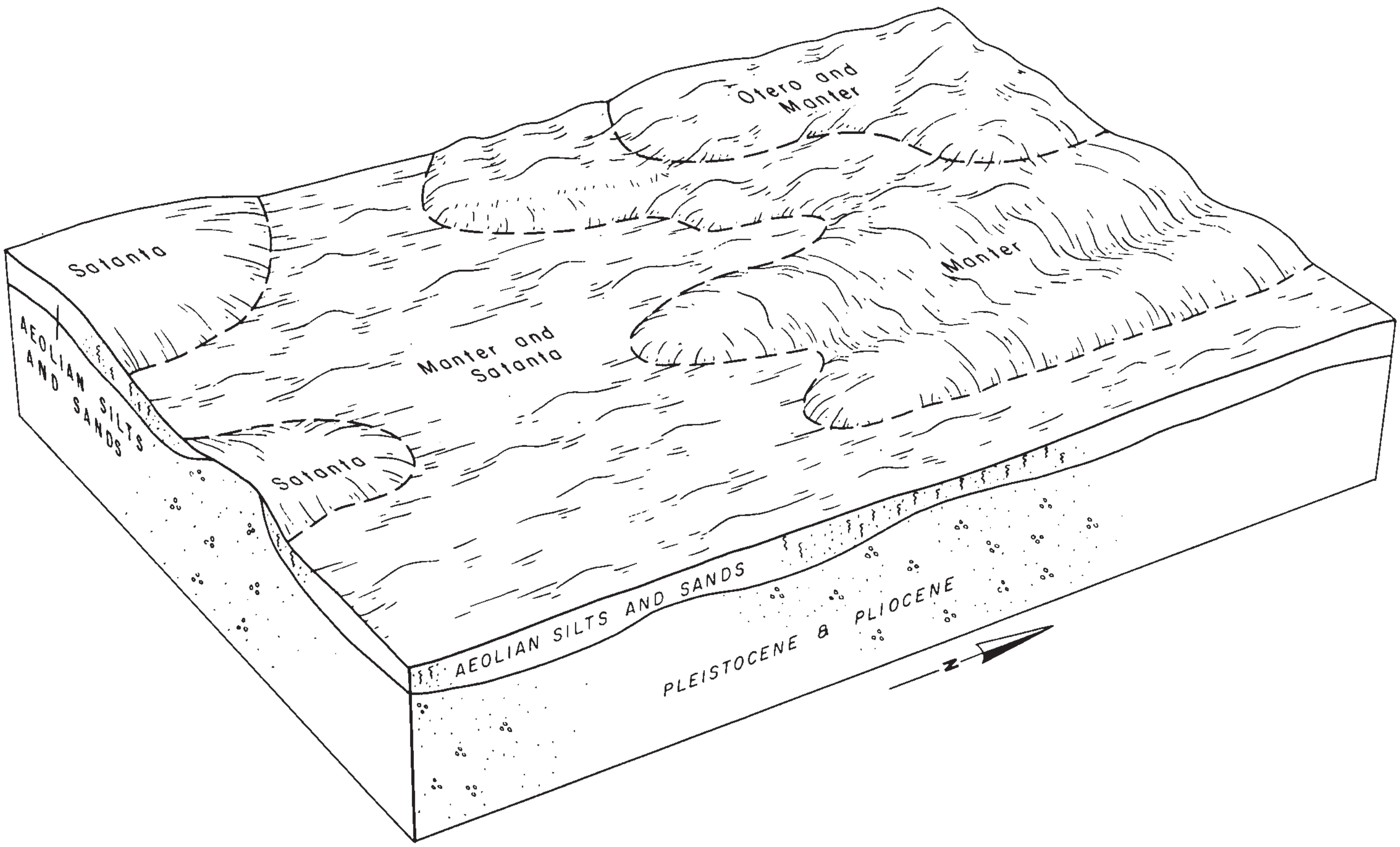



*Figure 4.*—**Diagram of soils of the Manter-Satanta association in the transition area between the sandhills and nearly level tableland.**

Otero soils are on convex ridges and knolls.

Most of this association is used for sorghum and wheat. Soil blowing is a hazard throughout the association and is particularly serious on the more sandy soils. Water erosion is also a hazard on the gently sloping loamy soils. Careful management is needed to control erosion and conserve water on all the soils of this association.

## 6. Pratt-Tivoli Association

*Deep, nearly level to steep sandy soils of the uplands.*

This soil association is on sandhills. It is undulating to hummocky.

This association makes up about 11 percent of the county. It is about 50 percent Pratt soils, 5 percent Tivoli soils, and 45 percent minor soils.

Pratt soils are well-drained, nearly level to rolling soils. The surface layer is brown loamy fine sand about 8 inches thick. The subsoil, about 16 inches thick, is yellowish-brown loamy fine sand. The underlying material is very pale brown loamy fine sand.

Tivoli soils are excessively drained, rolling to steep and hummocky soils on sandhills. They have a surface layer of brown fine sand about 4 inches thick. Below this is light yellowish-brown fine sand.

The minor soils of this association consist of Blown-out land and Mansic, Manter, and Otero soils. Small areas of Blown-out land occur where soil blowing has been active. Otero and Manter soils are undulating in areas between the hummocky, more sloping soils. Mansic soils are on low flats between the undulating soils.

Most of this association is in permanent grasses and used for range. Some areas of Pratt soils are cultivated. Soil blowing is the main hazard on the soils of this association. Under good management, mixed stands of tall and mid grasses produce enough forage for grazing and also help control soil blowing.

## 7. Mansic-Campus-Otero Association

*Deep, sloping to steep, calcareous loamy soils of the uplands*

This association is in a large area that is part of the drainage basin of Crooked Creek, the Cimarron River, and Sand Creek. It is dominantly sloping to steep (fig. 5).

This association makes up about 29 percent of the county. It is about 56 percent Mansic soils, 20 percent Campus soils, 13 percent Otero soils, and 11 percent minor soils.

Mansic soils are well-drained, sloping to steep soils on side slopes along drainageways. The surface layer is dark grayish-brown clay loam about 17 inches thick. The subsoil, about 10 inches thick, is pale-brown clay loam. The underlying material is very pale brown clay loam.

Campus soils are well-drained, sloping to strongly sloping soils that are closely intermingled with Canlon soils along drainageways and intermittent streams. The surface layer is dark grayish-brown clay loam about 7 inches thick. The subsoil, about 7 inches thick, is grayish-brown clay

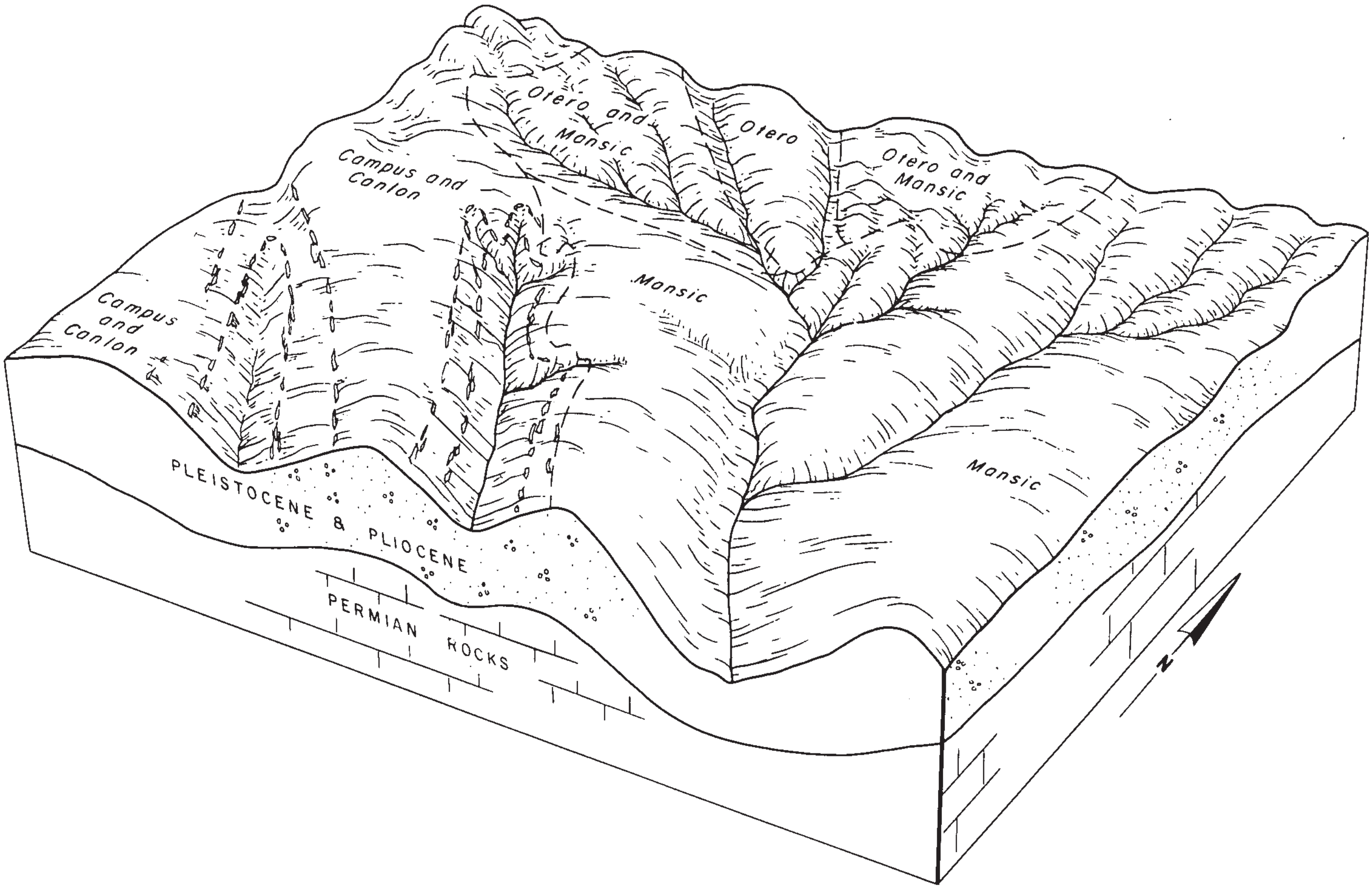



***Figure 5.*—Diagram of soils of the Mansic-Campus-Otero association in the Cimarron River drainage area.**

loam. The underlying material is very pale brown to pale-brown clay loam.

Otero soils are well-drained to somewhat excessively drained, sloping to strongly sloping soils on side slopes along drainageways. The surface layer is brown fine sandy loam about 8 inches thick. The next layer, about 21 inches thick, is pale-brown fine sandy loam. The underlying material is pale-brown sandy loam.

The minor soils of this association consist of Canlon and Uly soils and gravelly soils. Canlon soils are on the strongly sloping areas and on the steeper and more broken slopes. Uly soils are gently sloping and nearly level in areas between the tributaries of Crooked Creek and Sand Creek. The gravelly soils are steeper and are hilly.

Most of this association is in native grasses and used for

soil series is first described in detail, and then, briefly, the mapping units in that series are described. Unless specifically mentioned otherwise, it is to be assumed that what is stated about the soil series holds true for the mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

An important part of the description of each soil series is the soil profile, that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second is more detailed and is for those who need to make thorough and precise studies of soils. Color terms are for

Alluvial land, loamy, for example, does not belong to a soil series, but it is listed in alphabetic order along with the soil series.

Preceding the name of each mapping unit is a symbol that identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit are the capability unit, range site, and windbreak suitability group to which the mapping unit has been assigned. The pages on which the range sites and windbreak suitability groups are described are shown in the "Guide to Mapping Units" at the back of this survey.

The approximate acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the "Glossary," and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual *(11)*.[1]

The names, descriptions, and delineations of soils in this published soil survey do not always agree or join fully with soil maps of adjoining counties published at an earlier date. Differences are the result of better knowledge about soils or modification and refinements in soil series concepts. In addition, the correlation of a recognized soil is based upon the acreage of that soil and the dissimilarity to adjacent soils within the survey area. Frequently, it is more feasible to include soils that are small in extent along with similar soils, if management and response are similar, rather than to map them separately. The soil descriptions reflect such combinations. Other differences are brought about by the predominance of different soils in taxonomic units made up of two or three series. Still another difference may be caused by the range in slope allowed within the mapping unit for each survey.

[1] Italic numbers in parentheses refer to Literature Cited, p. 62.

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

| Soil | Acres | Percent |
|---|---|---|
| Alluvial land, loamy | 1,637 | 0.3 |
| Blown-out land | 1,060 | .2 |
| Campus-Canlon complex, 5 to 15 percent slopes | 47,951 | 7.7 |
| Harney silt loam, 0 to 1 percent slopes | 157,030 | 25.1 |
| Harney silt loam, 1 to 3 percent slopes | 16,821 | 2.7 |
| Harney silty clay loam, 1 to 3 percent slopes, eroded | 4,720 | .8 |
| Kanza soils | 4,611 | .7 |
| Leshara clay loam | 6,970 | 1.1 |
| Lesho clay loam | 1,913 | .3 |
| Likes loamy sand | 12,843 | 2.0 |
| Lincoln soils | 3,000 | .5 |
| Mansic clay loam, 0 to 1 percent slopes | 7,268 | 1.2 |
| Mansic clay loam, 1 to 3 percent slopes | 20,105 | 3.2 |
| Mansic clay loam, 3 to 6 percent slopes | 17,188 | 2.7 |
| Mansic clay loam, 3 to 6 percent slopes, eroded | 6,041 | 1.0 |
| Mansic clay loam, 6 to 15 percent slopes | 40,801 | 6.5 |
| Mansic-Manter complex, 1 to 4 percent slopes | 6,513 | 1.0 |
| Manter fine sandy loam, 0 to 1 percent slopes | 2,383 | .4 |
| Manter fine sandy loam, 1 to 3 percent slopes | 5,975 | 1.0 |
| Manter fine sandy loam, 1 to 3 percent slopes, eroded | 5,603 | .9 |
| Manter-Satanta fine sandy loams, 1 to 4 percent slopes | 7,882 | 1.3 |
| Missler silty clay loam, 0 to 1 percent slopes | 9,879 | 1.6 |
| Missler silty clay loam, 1 to 6 percent slopes | 4,028 | .6 |
| Ness silty clay | 10,404 | 1.7 |
| Otero fine sandy loam, 6 to 15 percent slopes | 9,661 | 1.5 |
| Otero-Mansic complex, 5 to 25 percent slopes | 40,807 | 6.5 |
| Otero-Manter fine sandy loams, 3 to 6 percent slopes | 4,896 | .8 |
| Pratt soils, 0 to 5 percent slopes | 25,489 | 4.1 |
| Pratt soils, 5 to 15 percent slopes | 32,326 | 5.2 |
| Rough broken land | 3,120 | .5 |
| Roxbury silt loam | 8,960 | 1.4 |
| Satanta fine sandy loam, 0 to 2 percent slopes | 3,785 | .6 |
| Satanta loam, 0 to 1 percent slopes | 5,081 | .8 |
| Satanta loam, 1 to 3 percent slopes | 2,627 | .4 |
| Spearville silty clay loam, 0 to 1 percent slopes | 36,060 | 5.7 |
| Tivoli fine sand, 10 to 25 percent slopes | 2,885 | .4 |
| Uly silt loam, 0 to 1 percent slopes | 8,197 | 1.3 |
| Uly silt loam, 1 to 3 percent slopes | 20,298 | 3.2 |
| Uly silt loam, 1 to 3 percent slopes, eroded | 2,597 | .4 |
| Uly silt loam, 3 to 6 percent slopes | 4,258 | .7 |
| Uly silt loam, 3 to 6 percent slopes, eroded | 3,709 | .6 |
| Wann loam | 2,181 | .3 |
| Yahola sandy loam | 4,417 | .7 |
| Intermittent lake | 1,175 | .2 |
| River | 1,213 | .2 |
| Total | 626,368 | 100.0 |

## Alluvial Land, Loamy

**An—Alluvial land, loamy** (0 to 1 percent slopes). This land type is on flood plains that are cut by meandering channels of intermittent streams in the uplands. The floors of the valleys are more than 150 feet wide. The soil material is mainly stratified calcareous loam and clay loam and, in places, thin layers of sandy loam.

Nearly all the acreage of Alluvial land, loamy, is in native grasses and used for range. It is well suited to this use. It generally is not suitable for cultivation because it is occasionally subject to flooding and because in most places it is bordered by sloping soils that are not suitable for cultivation. Grazing must be managed to encourage the growth of the best native forage plants. This can be done by using a proper stocking rate and practicing deferred grazing or rotation grazing. Proper location of fences, salt, and water helps distribute livestock over the range. Capability unit VIw-1 dryland; Loamy Lowland range site; Lowland windbreak suitability group.

## Blown-out Land

**Bo—Blown-out land** (5 to 15 percent slopes). This land type is on severely eroded areas and areas where loamy fine sand and sand have been deposited and continue to blow. The blowouts and eroded areas commonly form a trough-like or bowl-like design. The sides and bottom of the blowouts are mostly sand. Where the sand has been swept away, the bottom is calcareous sandy loam or clay loam. Blown-out land occurs mainly within areas of Pratt and Tivoli soils. Areas less than 20 acres in size within areas of Pratt and Tivoli soils and areas less than 5 acres in size within areas of Manter soils are shown on the detailed soil map by blowout symbols.

Vegetation is sparse over much of the area. The blowouts are barren or nearly barren, and the areas covered by deposited material are in annual weeds and grasses. Blown-out land is not suited to crops. Reseeding to native grass is about the only suitable practice. The areas need to be

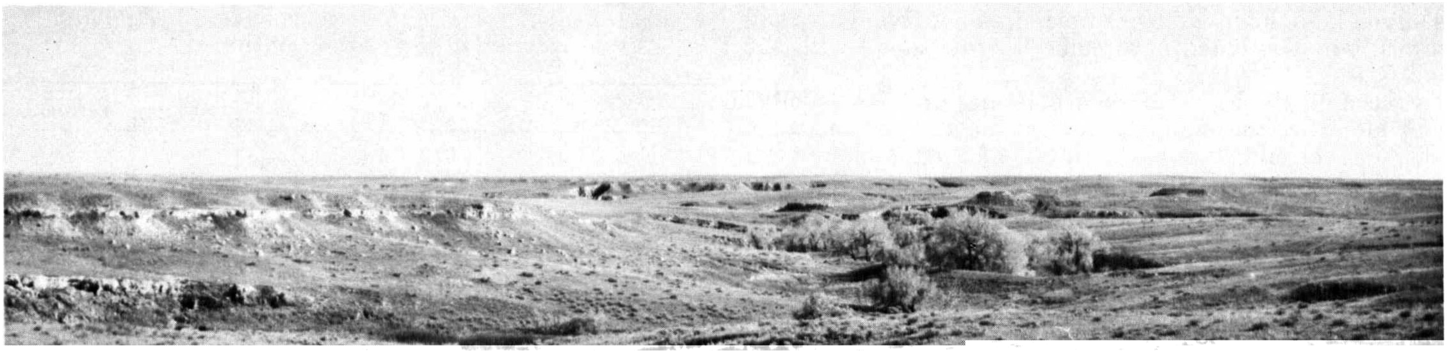


*Figure 6.*—**Typical landscape of Campus-Canlon complex, 5 to 15 percent slopes.**

fenced off until the vegetation is well established. Capability unit VIIe-1 dryland; Choppy Sands range site; not assigned to a windbreak suitability group.

## Campus Series

The Campus series consists of deep, well-drained, sloping soils on uplands. These soils formed in calcareous, partly consolidated old alluvium. The native vegetation is short and mid grasses.

In a representative profile the surface layer is dark grayish-brown, calcareous clay loam about 7 inches thick. The subsoil, about 7 inches thick, is grayish-brown, calcareous, friable clay loam. The underlying material is very pale brown and pale-brown, calcareous clay loam. The upper part contains numerous concretions of calcium carbonate; the lower part contains few concretions of calcium carbonate.

Permeability is moderate, and available water capacity is high. Fertility is medium. Runoff is medium to rapid.

Most of the acreage is in native grass.

Representative profile of Campus clay loam in an area of Campus-Canlon complex, 5 to 15 percent slopes, about 780 feet north and 660 feet east of the southwest corner of the southeast quarter of sec. 29, T. 33 S., R. 26 W.:

A1—0 to 7 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate, medium, granular structure; hard, friable; many roots; slight effervescence; moderately alkaline; gradual, smooth boundary.

B2—7 to 14 inches, grayish-brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; weak, medium, granular structure; hard, friable; many roots; few small, strongly cemented concretions of calcium carbonate; slight effervescence; moderately alkaline; diffuse, wavy boundary.

C1ca—14 to 30 inches, very pale brown (10YR 8/3) clay loam, very pale brown (10YR 7/3) moist; weak, medium, subangular blocky structure; slightly hard, friable; few roots; about 50 percent, by volume, weakly cemented concretions of calcium carbonate; strong effervescence; moderately alkaline; diffuse, wavy boundary.

C2—30 to 60 inches, pale-brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; massive; hard, friable; about 15 percent, by volume, concretions of calcium carbonate, mostly coatings and soft powdery masses; slight effervescence; moderately alkaline.

The A horizon ranges from dark grayish brown to grayish brown. The Cca horizon ranges from light brownish-gray to white loam or clay loam.

Campus soils are near Canlon and Mansic soils. They are deeper over beds of indurated caliche than Canlon soils. They have a stronger zone of calcium carbonate accumulation than Mansic soils.

**Cc—Campus-Canlon complex, 5 to 15 percent slopes.** This complex consists of sloping and strongly sloping soils along well-entrenched upland drainageways and intermittent streams. It is about 50 percent Campus clay loam, 25 percent Canlon loam, and 25 percent Mansic clay loam.

Campus clay loam is sloping on side slopes, and Mansic clay loam is sloping and strongly sloping along drainageways. Canlon loam is strongly sloping on the more broken slopes. Outcrops of slightly weathered caliche are common in the area.

The soils of this complex are nonarable. They are better suited to range than to other uses (fig. 6). The soils are productive, however, if they are properly managed. Grazing must be managed to encourage growth of the best native forage plants. This can be done by using a proper stocking rate and practicing deferred grazing or rotation deferred grazing. Proper location of fences, salt, and water helps distribute livestock over the range. Capability unit VIe-4 dryland; Campus soil in Limy Upland range site and Canlon soil in Shallow Limy range site; not assigned to a windbreak suitability group.

## Canlon Series

The Canlon series consists of shallow, well-drained and somewhat excessively drained, strongly sloping soils on uplands. These soils formed in material weathered from caliche. The native vegetation is mid grass.

In a representative profile the surface layer is grayish-brown, calcareous loam about 6 inches thick. The underlying material is white, hard or semihard caliche.

Permeability is moderate, and available water capacity is very low. Fertility is low. Runoff is medium to rapid.

Most of the acreage is in native grass.

Representative profile of Canlon loam in an area of Campus-Canlon complex, 5 to 15 percent slopes, about 420 feet south and 30 feet east of the northwest corner of the northeast quarter of sec. 28, T. 33 S., R. 26 W.:

A1—0 to 6 inches, grayish-brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; weak, fine, granular structure; hard, friable; many roots; scattered fragments of hard caliche; strong effervescence; moderately alkaline; clear, wavy boundary.

C—6 to 12 inches, white (10YR 8/2) caliche; about 60 percent, by volume, caliche fragments that range from 1 inch to 4 inches on the long axis; about 40 percent, by volume, soft powdery caliche and loamy material.

R—12 inches, white, hard caliche.

Depth to caliche ranges from 10 to 20 inches. The A horizon ranges from grayish brown to very pale brown.

Canlon soils are near Campus soils. They are shallower over beds of indurated caliche than Campus soils.

In Meade County, Canlon soils are mapped only with Campus soils.

## Harney Series

The Harney series consists of deep, well-drained, nearly level to gently sloping soils that occur on uplands through-

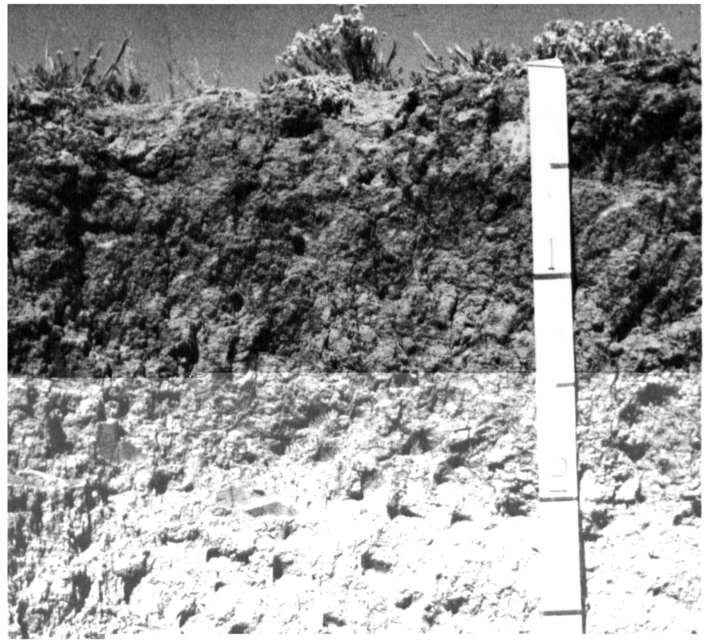


*Figure 7.*—**Profile of a Harney silt loam.**

B1—6 to 10 inches, dark grayish-brown (10YR 4/2) silty clay loam, dark brown (10YR 3/3) moist; moderate, medium, granular structure; hard, friable; neutral; gradual, smooth boundary.

B21t—10 to 15 inches, brown (10YR 5/3) silty clay loam, dark brown (10YR 3/3) moist; moderate, medium, subangular blocky structure; hard, friable; mildly alkaline; gradual, smooth boundary.

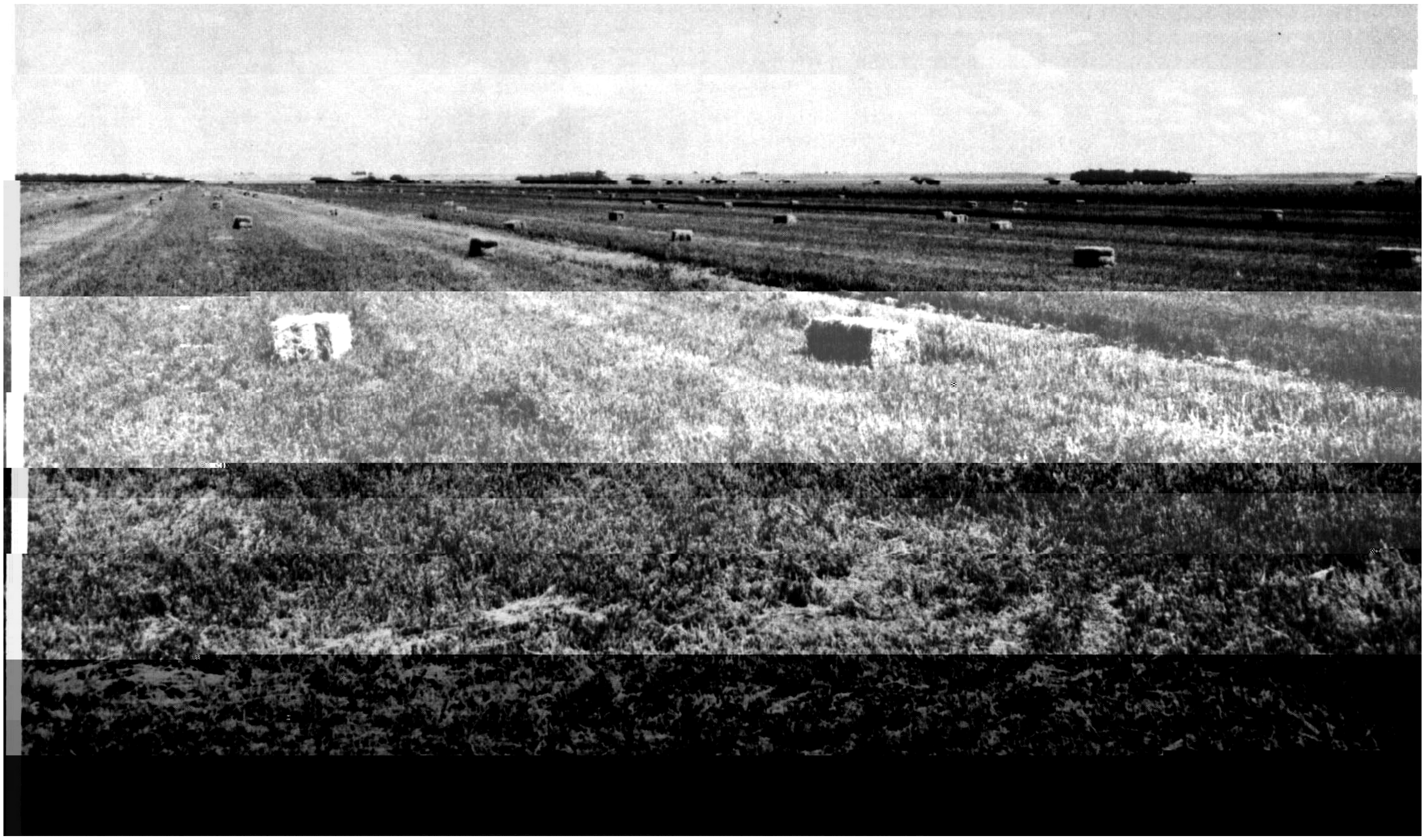


*Figure 8.*—Harvesting alfalfa on an irrigated Harney silt loam.

the series, but this difference does not alter the usefulness or behavior of the soils.

Harney soils are near Satanta, Spearville, and Uly soils. They have a more clayey B horizon than Satanta soils. They have a thicker transition between the A1 horizon and the B2t horizon than Spearville soils. They are more clayey in the B horizon and deeper over calcareous material than Uly soils.

**Ha—Harney silt loam, 0 to 1 percent slopes.** This nearly level soil is on broad areas in the uplands. It has the profile described as representative of the series.

Included with this soil in mapping were small areas of Spearville soils, soils that are similar to this Harney soil but that range from 12 to 18 inches deep over calcareous material, and small depressional areas of Ness soils.

This soil is well suited to dryfarmed and irrigated crops. Wheat and grain sorghum are suitable dryfarmed crops. Inadequate rainfall is the main limitation. Conserving moisture and controlling soil blowing are concerns of management. Summer fallowing is essential for storage of moisture, and stubble mulching is needed to reduce soil blowing. Contour farming, stripcropping, and terracing are also desirable.

should be used. Land leveling is commonly needed to prepare soil for gravity irrigation. Managing runoff from adjacent higher areas is a concern on some fields. Capability units IIc-1 dryland, I-1 irrigated; Loamy Upland range site; Silty Upland windbreak suitability group.

**Hb—Harney silt loam, 1 to 3 percent slopes.** This gently sloping soil is on uplands throughout the county. It has a profile similar to the one described as representative of the series, but the surface layer and subsoil are slightly thinner and free carbonates are at a shallower depth. Included in mapping were small areas of Uly soils.

This Harney soil is well suited to dryfarmed and irrigated crops. Wheat and grain sorghum are suitable dryfarmed crops. Controlling water erosion and soil blowing and conserving moisture are concerns of management. Terracing, contour farming, and good management of crop residue help control erosion and conserve moisture.

In irrigated areas suitable crops are corn, grain sorghum, wheat, and alfalfa. Good management of irrigated areas includes control of erosion, efficient use of water, and maintenance of fertility and tilth. The use of a cropping bility units IIe-1 dryland, IIe-1 irrigated; Loamy Upland range site; Silty Upland windbreak suitability group.

Kanza soils are near Leshara and Wann soils. They are more sandy and more poorly drained than those soils.

of management. This Leshara soil is well suited to crops if adequately protected from flooding. Good management of this soil for crops includes control of flooding and the use of crop residue to conserve moisture and to help control soil blowing. Wheat and grain sorghum are suitable dryfarmed crops.

In irrigated areas this soil is suited to wheat, grain sorghum, alfalfa, corn, and tame grasses. Good management of this soil under irrigation includes the maintenance or improvement of fertility and tilth, control of salinity, and the efficient use of water. The use of a cropping system that includes a deep-rooted legume, the use of crop residue, and the use of commercial fertilizer improve fertility, the content of organic matter, and tilth. Management that produces the most efficient use of irrigation water should be used. Land leveling is commonly needed to prepare soils for gravity irrigation.

Where this soil is used for range, it produces abundant forage from suitable native grasses. Good range management includes using a proper stocking rate and practicing deferred grazing or rotation deferred grazing. Proper location of fences, salt, and water helps distribute livestock over the range. Capability unit IIw-1 dryland, IIw-1 irrigated; Subirrigated range site; Subirrigated Lowland windbreak suitability group.

## Lesho Series

The Lesho series consists of somewhat poorly drained, nearly level soils that are moderately deep over sand. These soils are on the flood plains of Crooked Creek. They formed in calcareous alluvium. The native vegetation is mid and tall grasses.

In a representative profile the surface layer is grayish-brown, calcareous clay loam about 19 inches thick. The

shallower over coarse sand and gravel than Leshara soils. They are more clayey than Lincoln and Wann soils.

**Lh—Lesho clay loam.** This nearly level soil is on the flood plains of Crooked Creek. Slopes are 0 to 1 percent. Included in mapping were small areas of Leshara and Wann soils and saline spots scattered throughout the area.

This Lesho soil is moderately well suited to irrigated crops if it is irrigated late in summer when moisture is lacking. It is not well suited to dry-farmed crops. Wheat and grain sorghum are the main crops grown. The root zone is limited in depth, and the fluctuating water table is detrimental to deep-rooted crops, such as alfalfa. Conserving moisture and controlling soil blowing are also concerns of management. Good management of crop residue is the most effective way to conserve moisture and control soil blowing on this soil.

Under irrigation this soil is suited to wheat, grain sorghum, and corn. Good management is needed to maintain and improve fertility and tilth and to control salinity. The use of a cropping system that includes legumes, the use of crop residue, and the use of commercial fertilizer help improve fertility and tilth and increase the content of organic matter. Management that produces the most efficient use of irrigation water is needed. Land leveling is commonly needed to prepare soils for gravity irrigation.

Where this soil is used for range, it produces abundant forage from suitable native grasses. Good range management includes using a proper stocking rate and practicing deferred grazing. Proper location of fences, salt, and water helps distribute livestock over the range. Capability unit IIIw-3 dryland, IIIw-3 irrigated; Subirrigated range site; Subirrigated Lowland windbreak suitability group.

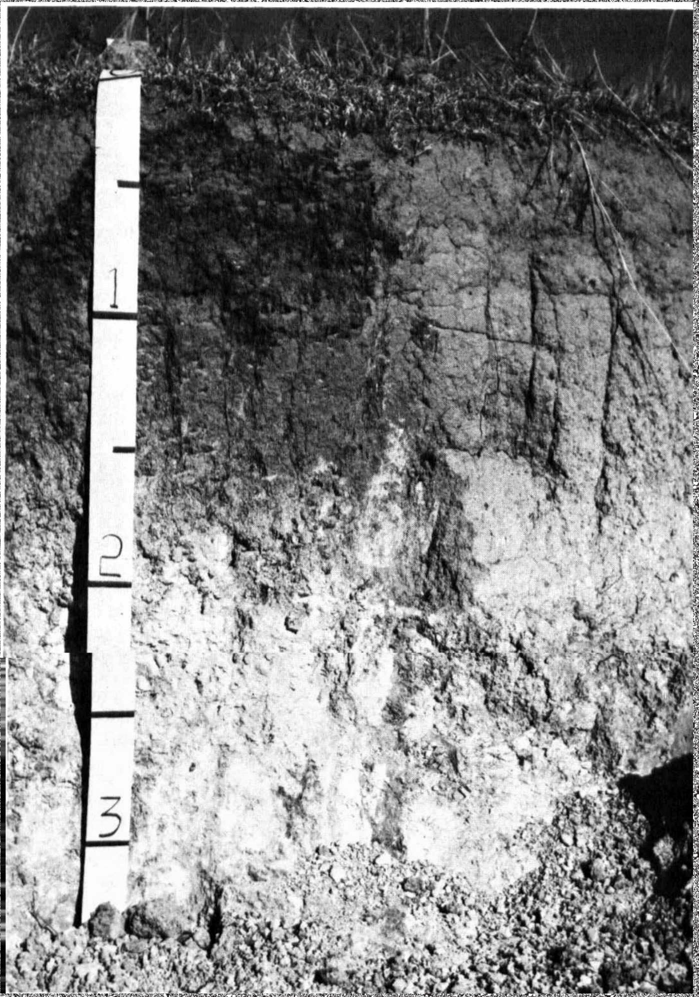
## Likes Series

plains. Slopes are 0 to 3 percent. Included in mapping were small areas of Tivoli and Yahola soils.

This Likes soil is not suitable for dryland crops because

ing material is very pale brown clay loam that contains a few small, hard and soft concretions of carbonate.

Permeability is moderate, and available water capacity



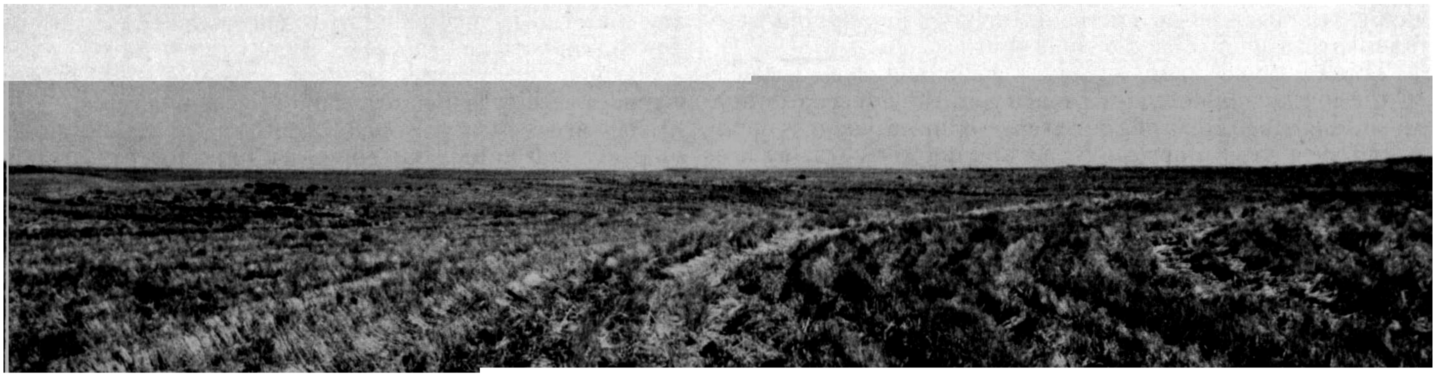


*Figure 10.*—**Subsurface tillage keeps wheat stubble on the surface and provides a protective cover for the soil in this area of Mansic clay loam, 3 to 6 percent slopes.**

percent, by volume, concretions of calcium carbonate; strong effervescence; moderately alkaline.

Conserving moisture and controlling soil blowing are concerns of management. Summer fallowing is essential for erosion and conserving moisture are the main concerns of management. Soil blowing is a hazard unless the soil is protected by vegetation or crop residue. Terracing, contour

residue on the surface conserve moisture and prevent further erosion and soil blowing.

No areas of this soil in the county are now irrigated. If

*Figure 11.*—**Stockwater pond on Mansic clay loam, 6 to 15 percent slopes. The pond is stocked with fish, and it provides water for livestock and for recreational facilities.**

range site; Silty Upland windbreak suitability group. Manter soils in Sandy range site; Sandy Upland windbreak suitability group.

## Manter Series

The Manter series consists of deep, well-drained, nearly level and undulating soils on uplands. These soils formed in sandy eolian sediment. The native vegetation is mid and tall grasses.

In a representative profile the surface layer is brown fine sandy loam about 9 inches thick. The subsoil, about 14 inches thick, is brown, friable fine sandy loam. The underlying material is brown, calcareous fine sandy loam. The upper part contains threads of calcium carbonate and is more calcareous than the lower part.

Permeability is rapid, and available water capacity is moderate. Fertility is high. Runoff is slow.

Most areas are used for cultivated crops, mainly sorghum and wheat.

Representative profile of Manter fine sandy loam, 1 to 3 percent slopes, in grassland, about 600 feet west and 30 feet north of the center of sec. 32, T. 33 S., R. 29 W.:

A1—0 to 9 inches, brown (7.5YR 4/2) fine sandy loam, dark brown (7.5YR 3/2) moist; weak, medium, granular structure; hard, very

Cca—23 to 32 inches, brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 4/4) moist; weak, coarse, subangular blocky structure; slightly hard, very friable; few roots; few wormcasts; threads of calcium carbonate; strong effervescence; moderately alkaline; gradual, smooth boundary.

C—32 to 60 inches, brown (7.5YR 5/4) fine sandy loam, dark brown (7.5 YR 4/4) moist; weak, coarse, subangular blocky structure; slightly hard, very friable; few roots; slight effervescence; moderately alkaline.

Reaction in the solum ranges from mildly alkaline to moderately alkaline, and depth to calcareous material ranges from 15 to 30 inches.

The A horizon ranges from 7 to 12 inches in thickness and is dark grayish brown to brown. The B2t horizon ranges from dark brown to light yellowish brown.

Manter soils are near Pratt and Satanta soils. They have a darker colored surface layer and are less sandy than Pratt soils. They are more sandy than Satanta soils.

**Mr—Manter fine sandy loam, 0 to 1 percent slopes.** This nearly level soil is between sandhills and hardlands. It has a profile similar to the one described as representative of the series, but the surface layer and subsoil are slightly thicker. Included in mapping were small areas of Satanta soils and eroded Manter soils that have slopes of 1 to 3 percent.

This Manter soil is well suited to dryfarmed and irrigated crops. Wheat, grain sorghum, and forage sorghum are suitable dryfarmed crops. Soil blowing is a serious cropping, and terracing are also desirable.

In irrigated areas suitable crops are wheat, grain sorghum, alfalfa, and tame grasses for hay and pasture. Good management of this soil under irrigation includes the maintenance or improvement of fertility and tilth. The use of a cropping system that includes legumes and the use of crop residue help maintain and improve fertility and tilth. Management that produces the most efficient use of irrigation water should be used. Land leveling is commonly needed for uniform distribution of water. Underground pipe prevents water loss and increases the efficiency of the system. Capability units IIIe-4 dryland, IIs-1 irrigated; Sandy range site; Sandy Upland windbreak suitability group.

**Ms—Manter fine sandy loam, 1 to 3 percent slopes.** This gently sloping soil is on undulating areas of the uplands. It has the profile described as representative of the series. Included in mapping were small areas of Satanta soils and eroded Manter soils that have slopes of 1 to 3 percent.

This Manter soil is mostly dryfarmed. Grain sorghum and wheat are suitable dryfarmed crops. Soil blowing is a

irrigated; Sandy range site; Sandy Upland windbreak suitability group.

**Mu—Manter-Satanta fine sandy loams, 1 to 4 percent slopes.** This undifferentiated unit is on gently undulating ridges and mounds and on low, nearly level areas between the mounds. It is about 55 percent uneroded Manter fine sandy loam, 25 percent Satanta fine sandy loam, 10 percent eroded Manter fine sandy loam, and 10 percent Harney silt loam.

The uneroded Manter fine sandy loam is gently sloping on areas that range from weakly convex to weakly concave. The eroded Manter fine sandy loam is on the most convex knobs and ridges. Harney silt loam and Satanta fine sandy loam are on the low, nearly level areas between the mounds.

Much of the acreage is used for dryfarmed wheat and sorghum. Soil blowing is a serious hazard unless the surface is protected by an adequate cover. Maintaining continuous and adequate crop residue on the surface of the soil conserves moisture and helps control soil blowing. Stripcropping is also desirable.

Although these soils are suited to irrigated wheat, sor-

The solum ranges from 19 to 30 inches in thickness. Reaction in the solum ranges from mildly alkaline to moderately alkaline, and depth to calcareous material ranges from 0 to 15 inches.

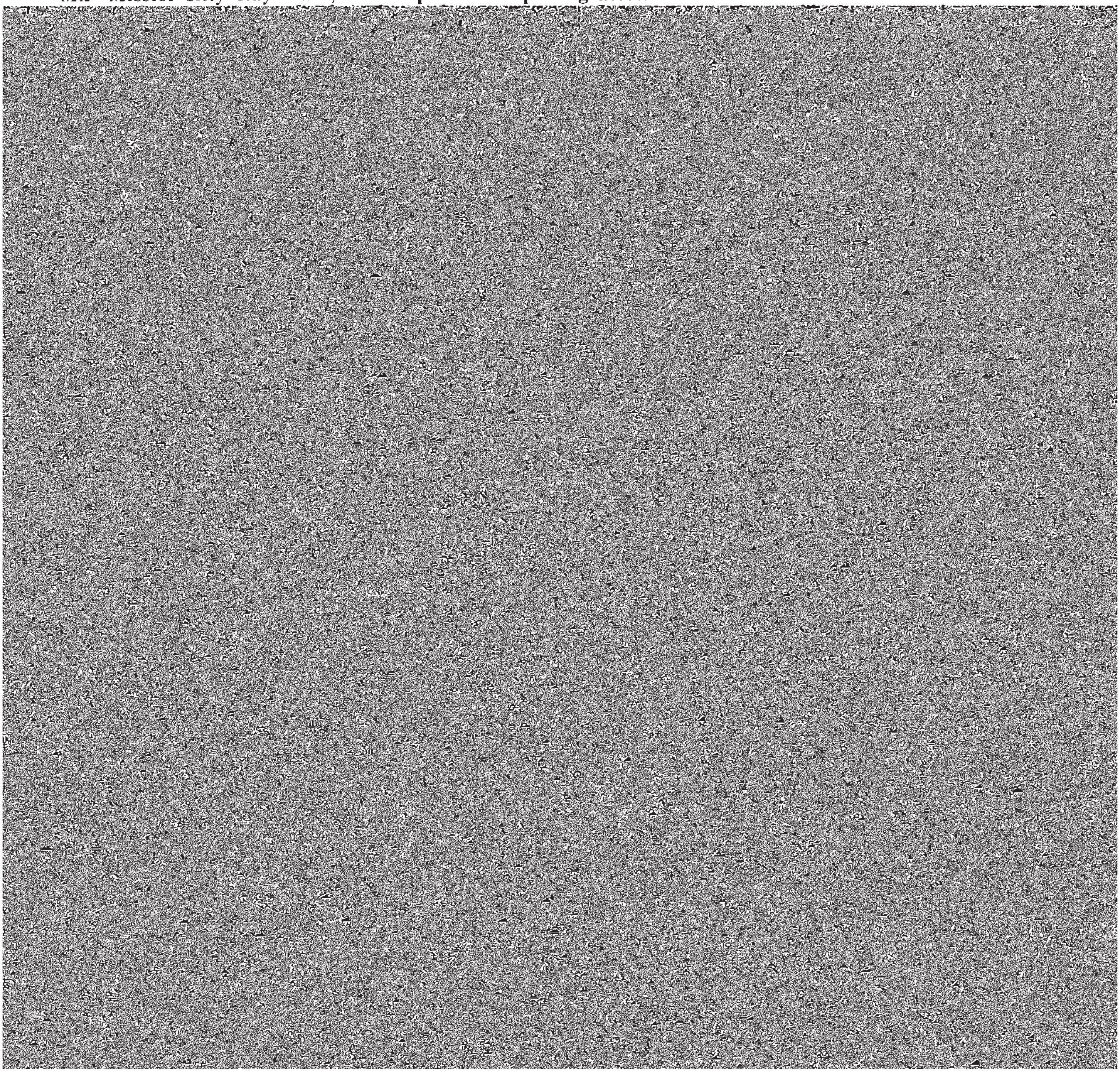
The A horizon ranges from 8 to 15 inches in thickness and is dark gray to grayish brown. The B2 horizon ranges from grayish-brown to pale-brown silty clay loam or silty clay.

Missler soils are near Harney, Leshara, Ness, and Roxbury soils. They have a less clayey, more poorly defined B2 horizon and are shallower over lime than Harney soils. They are better drained than Leshara soils. They are less clayey than Ness soils, which are in shallow depressions. They are more clayey and are not dark colored to so great a depth as Roxbury soils.

**Mx—Missler silty clay loam, 0 to 1 percent slopes.**

## Ness Series

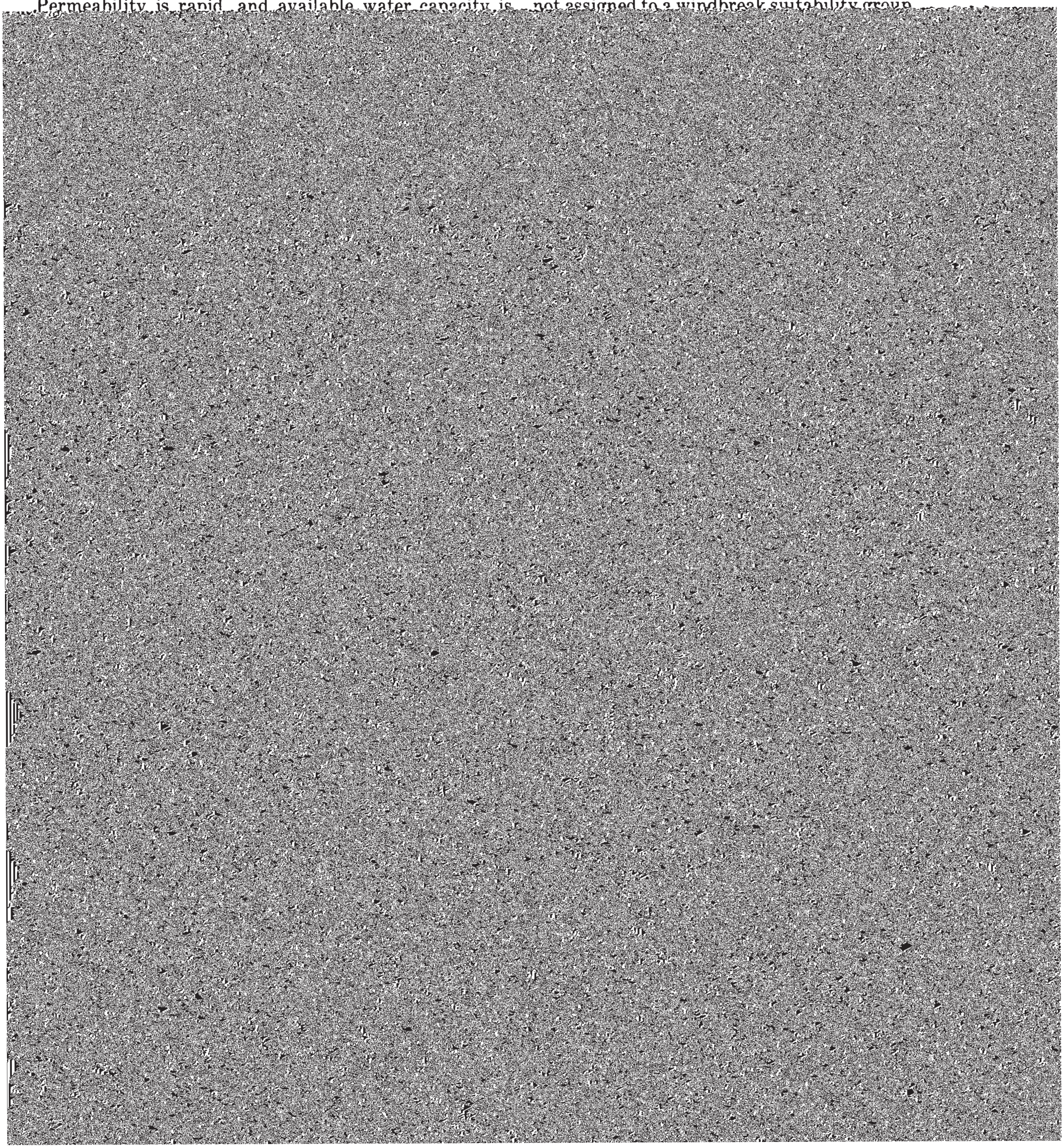
The Ness series consists of deep, poorly drained, nearly level soils. These soils are on the floor of depressions throughout the uplands and terraces. They formed in calcareous fine-textured sediment. Locally, the depressions are called potholes or buffalo wallows. Because they are enclosed and have no outlet, they hold water for periods of several days to a week or more, or until the water soaks into the soil or evaporates. The native vegetation is mostly annual and perennial weeds and a smaller amount of mid grasses.



calcareous fine sandy loam about 8 inches thick. The next layer, about 21 inches thick, is pale-brown, calcareous, very friable fine sandy loam. The underlying material is pale-brown, calcareous light sandy loam.

Permeability is rapid, and available water capacity is

ticing deferred grazing or rotation deferred grazing. Proper location of fences, salt, and water helps distribute livestock over the range. Capability unit VIe-5 dryland; Otero soil in Sandy range site, Mansic soil in Limy Upland range site; not assigned to a windbreak suitability group.



ish brown to pale brown. The B horizon ranges from brown to light yellowish-brown loamy fine sand or loamy sand.

Pratt soils are near Manter and Tivoli soils. They are more sandy than Manter soils and are less sandy than Tivoli soils.

**Pr—Pratt soils, 0 to 5 percent slopes.** These nearly level to gently rolling soils are on undulating to slightly hummocky areas in the southern and northeastern parts of the county. They have a profile similar to the one described as representative of the series, but in places the surface layer is fine sand.

Included with these soils in mapping were areas of soils that are similar to these Pratt soils but that are calcareous within 12 inches of the surface and have a more sandy surface layer. Also included were small areas of Manter soils.

These Pratt soils are not well suited to crops, particularly wheat, because of the low available water capacity and the high susceptibility to soil blowing. They can be cultivated safely, however, if soil blowing is controlled. Grain sorghum is the main crop grown on these soils. The low available water capacity and the susceptibility to soil blowing limit the effectiveness of summer fallow. Maintaining continuous and adequate crop residue is essential.

Although these soils are suited to irrigated forage sorghum, grain sorghum, and corn, only a small acreage is irrigated. Good management of these soils under irrigation must provide for control of soil blowing, efficient use of water, and maintenance of fertility and tilth. Sprinkler irrigation is the only practical method of irrigation on these soils. Capability units IVe-1 dryland, IIIe-2 irrigated; Sands range site; Sandy Upland windbreak suitability group.

**Pt—Pratt soils, 5 to 15 percent slopes.** These gently rolling to rolling soils are on hummocky areas in the southern and northeastern parts of the county. They have a profile similar to the one described as representative of the series, but the surface layer is fine sand. Included in mapping were small areas of Tivoli soils and small blowouts less than 10 acres in size.

These Pratt soils are not suited to dryfarmed crops because of the low available water capacity and the susceptibility to erosion. Most of the acreage is in native grasses. A

with limestone. Included in mapping were small areas of Otero and Mansic soils and gravelly soils. Runoff is rapid, and geologic erosion is active.

All of the acreage of Rough broken land is in range that consists of a moderate to sparse stand of mid and tall native grasses. The areas can be grazed if care is taken to prevent overgrazing, which results in erosion. Grazing must be managed to encourage growth of the best native forage plants. This can be done by using a proper stocking rate and practicing deferred grazing or rotation deferred grazing. Proper location of fences, salt, and water helps distribute livestock over the range. Capability unit VIIs-1 dryland; Shallow Limy range site; not assigned to a windbreak suitability group.

## Roxbury Series

The Roxbury series consists of deep, well-drained nearly level soils on alluvial fans and terraces along Crooked Creek. These soils formed in somewhat stratified loamy alluvium. The native vegetation is mid and tall grasses.

In a representative profile the surface layer is grayish-brown, calcareous silt loam about 20 inches thick. The subsoil, about 8 inches thick, is dark grayish-brown, calcareous, friable silty clay loam. The underlying material is very pale brown and pale-brown, calcareous silty clay loam.

Permeability is moderate, and available water capacity is very high. Fertility is high. Runoff is medium to slow. Crops generally benefit from the extra moisture gained through the accumulation of runoff from adjacent areas, but occasionally they are damaged by flash floods.

Most areas are used for cultivated crops, mainly sorghum, wheat, and alfalfa.

Representative profile of Roxbury silt loam, about 350 feet west and 10 feet south of the center of sec. 11, T. 31 S., R. 27 W.:

A1—0 to 20 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak, granular structure; slightly hard, friable; slight effervescence; moderately alkaline; gradual, smooth boundary.

B2—20 to 28 inches, dark grayish-brown (10YR 4/2) silty clay loam, Alfalfa is also grown in some areas. Although some extra moisture is received in the form of runoff from adjacent areas inadequate rainfall is the main limitation. Conserving moisture and controlling soil blowing also are concerns of management on this soil. Summer fallowing is essential for storage of moisture, and stubble mulching is needed to reduce soil blowing. Stripcropping is also desirable. In suitable areas contour farming and terracing can be used.

Roxbury soils are among the most productive soils in the soils and are well suited to dryfarmed and irrigated crops. Wheat and grain sorghum are suitable dryfarmed crops. Alfalfa is also grown in some areas. Although some extra moisture is received in the form of runoff from adjacent areas inadequate rainfall is the main limitation. Conserving moisture and controlling soil blowing also are concerns of management on this soil. Summer fallowing is essential for storage of moisture, and stubble mulching is needed to reduce soil blowing. Stripcropping is also desirable. In suitable areas contour farming and terracing can be used.

In irrigated areas suitable crops are wheat, grain sorghum, corn, alfalfa, and soybeans. Good management of this soil under irrigation includes the maintenance or improvement of fertility and tilth, the use of crop residue to maintain organic matter, and the application of commercial fertilizer as needed. Management that produces the most efficient use of irrigation water should be used. Land leveling is commonly needed to prepare soils for gravity irrigation. Runoff from adjacent higher areas is a concern of management on some fields. Capability units IIc-2 dryland, I-1 irrigated; Loamy Terrace range site; Lowland windbreak suitability group.

## Satanta Series

The Satanta series consists of deep, well-drained, nearly level to gently undulating or gently sloping soils on uplands. These soils formed in loamy eolian material. The native vegetation is short and mid grasses.

In a representative profile the surface layer is grayish-brown loam about 6 inches thick. The subsoil is about 23 inches thick. The upper part is dark grayish-brown, friable clay loam; the middle is brown, friable clay loam; and the lower part is pale-brown, friable clay loam that is calcareous and contains a few threads of calcium carbonate. The underlying material is pale-brown, calcareous clay loam.

Permeability is moderate, and available water capacity is high. Fertility is high. Runoff is slow to medium.

Most areas are used for cultivated crops, mainly wheat and sorghum.

Representative profile of Satanta loam, 0 to 1 percent slopes, about 1,590 feet east of the center of sec. 32, T. 31 S., R. 26 W.:

Ap—0 to 6 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak, medium, granular structure; hard, friable; neutral; clear, smooth boundary.

B1—6 to 12 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak and moderate, medium, granular structure; hard, friable; neutral; gradual, smooth boundary.

B2t—12 to 23 inches, brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; moderate, medium, granular structure; hard, friable; mildly alkaline; gradual, smooth boundary.

B3ca—23 to 29 inches, pale-brown (10YR 6/3) clay loam, dark brown (10YR 4/3) moist; weak, medium, granular structure; hard, friable; few threads of calcium carbonate; strong effervescence; moderately alkaline; gradual, smooth boundary.

C—29 to 60 inches, pale-brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; massive; hard, friable; strong effervescence; moderately alkaline.

The solum ranges from 24 to 36 inches in thickness. Reaction in the solum ranges from neutral to moderately alkaline, and depth to calcareous material ranges from 18 to 36 inches.

The A horizon ranges from 6 to 12 inches in thickness. It is dark grayish-brown to brown loam or fine sandy loam. The B horizon ranges from dark grayish-brown to pale-brown loam to sandy clay loam.

Satanta soils are near Harney and Manter soils. They have a more sandy A horizon and a less clayey B horizon than Harney soils. They have a more clayey B horizon than Manter soils.

**Sa—Satanta fine sandy loam, 0 to 2 percent slopes.** This nearly level to gently undulating soil is on uplands. It has a profile similar to the one described as representative of the series, but the surface layer is fine sandy loam and the subsoil is sandy clay loam. Included in mapping were small areas of uneroded Manter soils, eroded Manter soils, Harney soils, and Mansic soils.

This Satanta soil is well suited to dryfarmed and irrigated crops. Wheat and grain sorghum are suitable dryfarmed crops. Controlling soil blowing and conserving moisture are the main concerns of management. Water erosion is also a hazard on the sloping areas. Maintaining continuous and adequate crop residue on the surface of the soil helps control soil blowing and conserve moisture. Contour farming, stripcropping, and terracing are also desirable.

In irrigated areas suitable crops are grain sorghum, forage sorghum, corn, wheat, and alfalfa. Good management of this soil under irrigation includes control of erosion, efficient use of water, and maintenance of fertility and tilth. The use of crop residue to maintain organic matter and the application of commercial fertilizer help maintain and improve fertility and tilth. Erosion can be controlled and water efficiently used by land leveling, irrigating on the contour, and using sprinkler irrigation on close-growing crops. Capability units IIe-2 dryland, IIe-2 irrigated; Sandy range site; Sandy Upland windbreak suitability group.

**Sb—Satanta loam, 0 to 1 percent slopes.** This nearly level soil is on uplands. It is inextensive but widely scattered throughout the county. It has the profile described as representative of the series. Included in mapping were small areas of Uly and Harney soils.

This Satanta soil is well suited to dryfarmed and irrigated crops. Wheat and grain sorghum are suitable dryfarmed crops. Inadequate rainfall is the main limitation. Conserving moisture and controlling soil blowing are concerns of management. Summer fallowing is essential for storage of moisture, and stubble mulching is needed to reduce soil blowing. Contour farming, stripcropping, and terracing are also desirable.

In irrigated areas suitable crops are grain sorghum, corn, wheat, and alfalfa. Good management of this soil under irrigation includes the maintenance or improvement of fertility and tilth, the use of crop residue to maintain organic matter, and the application of commercial fertilizer as needed. Management that produces the most efficient use of irrigation water should be used. Land leveling is commonly needed to prepare soils for gravity irrigation. Capability units IIc-1 dryland, I-1 irrigated; Loamy Upland range site; Silty Upland windbreak suitability group.

**Sc—Satanta loam, 1 to 3 percent slopes.** This gently sloping soil is on uplands. It has a profile similar to the one

## Spearville Series

The Spearville series consists of deep, well drained to moderately well drained, nearly level soils on uplands. These soils formed in loess. The native vegetation is short and mid grasses.

In a representative profile (fig. 12) the surface layer is grayish-brown silty clay loam about 6 inches thick. The subsoil is about 18 inches thick. The upper part is dark grayish-brown, very firm silty clay; the lower part is grayish-brown, firm silty clay loam that is calcareous and contains a few small concretions and threads of calcium carbonate. The underlying material is pale-brown, calcareous silty clay loam and silt loam.

Permeability is slow, and available water capacity is high. Fertility is high. Runoff is slow to very slow.

Most areas are used for cultivated crops.

Representative profile of Spearville silty clay loam, 0 to 1 percent slopes, in a cultivated field, about 300 feet south and 100 feet east of the northwest corner of sec. 21, T. 30 S., R. 28 W.:

Ap—0 to 6 inches, grayish-brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak, medium, granular structure; hard, friable; neutral; clear, smooth boundary.

B2t—6 to 18 inches, dark grayish-brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate and weak, medium, blocky structure; very hard, very firm; mildly alkaline; gradual, smooth boundary.

B3ca—18 to 24 inches, grayish-brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; moderate, medium, blocky structure; hard, firm; few, small, soft masses and threads of calcium carbonate; strong effervescence; moderately alkaline; gradual, smooth boundary.

Cca—24 to 30 inches, pale-brown (10YR 6/3) silty clay loam, brown (10YR 5/3) moist; moderate, medium, granular structure; hard, firm; thin films and streaks of segregated calcium carbonate; strong effervescence; moderately alkaline; gradual,

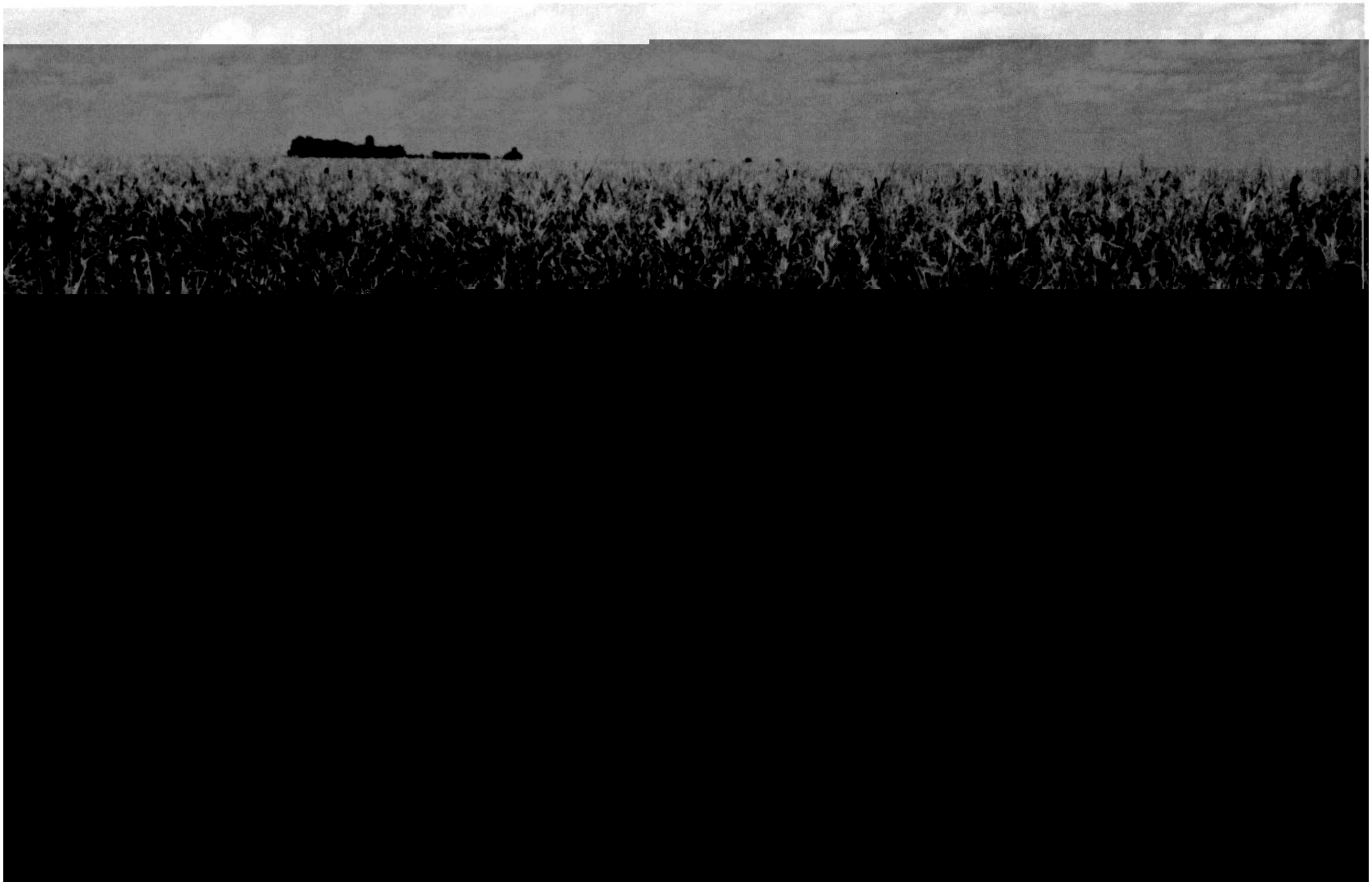


*Figure 13.*—An excellent crop of irrigated corn on Spearville silty clay loam, 0 to 1 percent slopes.

includes the maintenance or improvement of soil structure,

cent slopes, in native grass, about 740 feet east and 300 feet

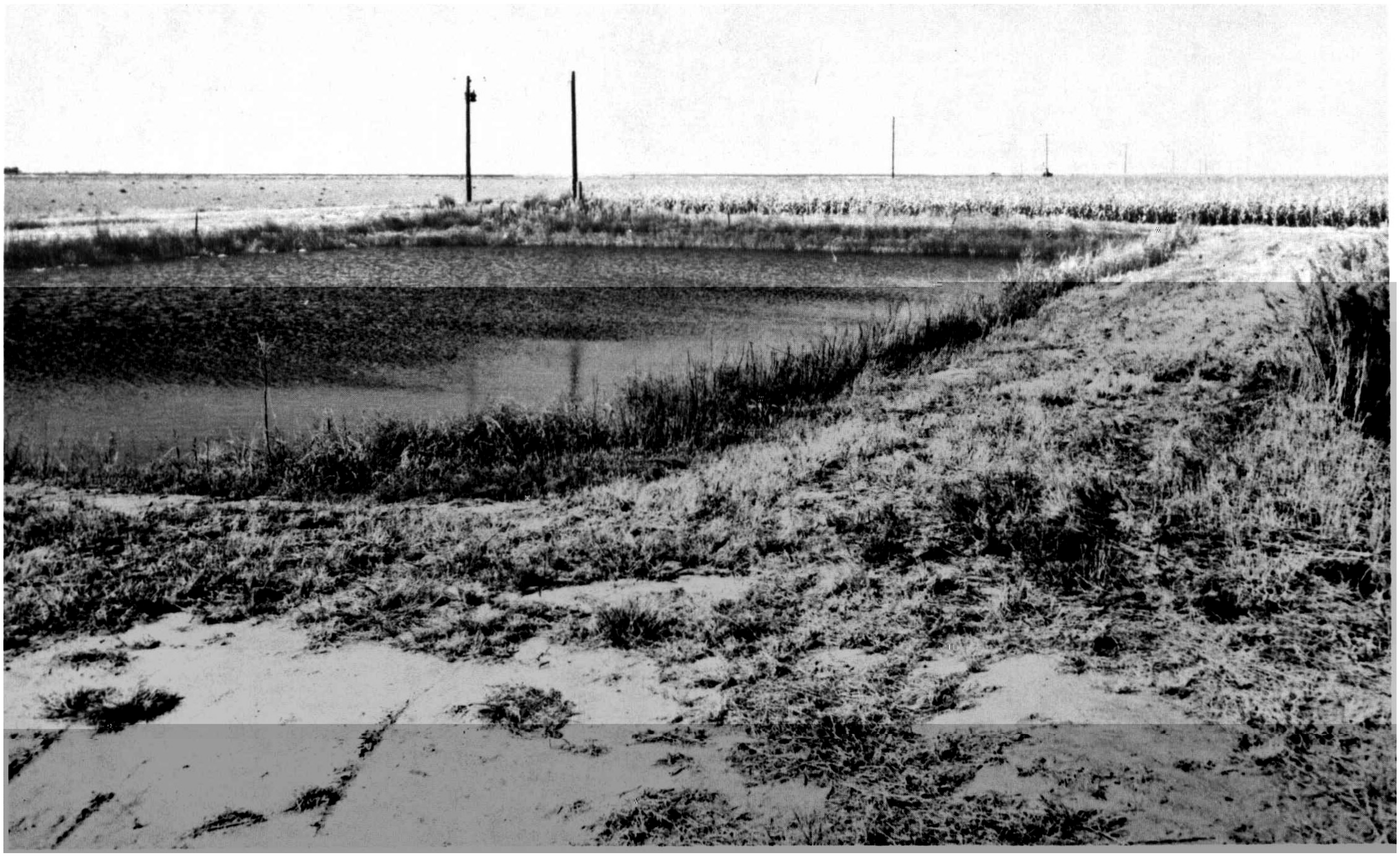


*Figure 14.*—**Tailwater recovery pit on Spearville silty clay loam, 0 to 1 percent slopes. The pit conserves water as it collects irrigation tailwater for reuse.**

Choppy Sands range site; not assigned to a windbreak suitability group.

## Uly Series

The Uly series consists of deep, well-drained, nearly level to sloping soils on uplands throughout the county. These soils formed in calcareous loess. The native vegetation is short, mid, and tall grasses.

In a representative profile the surface layer is grayish-brown silt loam about 6 inches thick. The subsoil, about 8 inches thick, is dark grayish-brown, friable light silty clay loam. The underlying material is pale-brown, calcareous silt loam.

Permeability is moderate, and available water capacity is high. Fertility is high. Runoff is slow to rapid.

subangular blocky structure; hard, friable; few wormcasts; mildly alkaline; gradual, smooth boundary.

C—14 to 60 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; massive; soft, very friable; strong effervescence; moderately alkaline.

The solum ranges from 12 to 24 inches in thickness. Depth to calcareous material ranges from 8 to 15 inches. The A horizon ranges from dark grayish brown to grayish brown.

Uly soils are near Harney and Mansic soils. They have a less clayey B horizon and are shallower over calcareous material than Harney soils. They have more silty A and B horizons than Mansic soils.

**Ua—Uly silt loam, 0 to 1 percent slopes.** This nearly level soil is on uplands throughout the county. It has the profile described as representative of the series. Included in mapping were small areas of Harney soils.

This Uly soil is well suited to dryfarmed and irrigated crops. Wheat and grain sorghum are suitable dryfarmed tilth, the use of crop residue to maintain organic matter, and the application of commercial fertilizer as needed. Management that produces the most efficient use of irrigation water should be used. Land leveling is commonly needed to prepare soils for gravity irrigation. Capability units IIc-1 dryland, I-1 irrigated; Loamy Upland range site; Silty Upland windbreak suitability group.

**Ub—Uly silt loam, 1 to 3 percent slopes.** This gently sloping soil is on uplands, mostly in the northern half of the county. It has a profile similar to the one described as representative of the series, but the surface layer and subsoil are slightly thinner. Included in mapping were small areas of Harney soils.

This Uly soil is well suited to dryfarmed crops but not to irrigated crops. Suitable dryfarmed crops are wheat and grain sorghum. Controlling water erosion and conserving moisture are the main concerns of management. Soil blowing is a hazard unless the soil is protected by vegetation or crop residue. Terracing, contour farming (fig. 16), and keeping crop residue on the surface help control runoff and erosion and conserve moisture.

Although this soil is not well suited to irrigation, irrigated crops can be grown. Suitable irrigated crops are corn, grain sorghum, and wheat. Good management of irrigated areas includes control of erosion, efficient use of water, and maintenance of fertility and tilth. The use of a cropping system that includes close-growing crops and deep-rooted legumes, the use of crop residue, and the use of commercial fertilizer and manure help maintain and improve fertility and tilth. Land leveling, irrigating on the contour, and irrigating with a sprinkler system supplemented with terraces help reduce erosion. Underground pipe and gated pipe prevent loss of water by evaporation and deep percolation. Capability units IIe-3 dryland, IIe-3 irrigated; Loamy Upland range site; Silty Upland windbreak suitability group.

**Uc—Uly silt loam, 1 to 3 percent slopes, eroded.** This gently sloping soil is on convex ridges of the uplands. In about 25 percent of the area, the soil has been so eroded that the surface layer is thinner, is lighter colored, and has calcareous material at a shallower depth than the surface layer in the profile described as representative of the series. Included in mapping were areas of Harney and Mansic soils.

Most of the acreage of this Uly soil is dryfarmed, but a few areas are irrigated. Wheat and grain sorghum are the main crops. In calcareous areas grain sorghum shows signs of chlorosis during early growth. Controlling water erosion and conserving moisture are the main concerns of management. Soil blowing is a hazard unless the soil is protected by vegetation or crop residue. Terracing, contour farming, and keeping crop residue on the surface help control runoff and erosion and conserve moisture.

Although this gently sloping soil is not well suited to irrigation, some areas are irrigated. Good management of this soil in irrigated areas includes control of erosion, efficient use of water, and maintenance of fertility and tilth. The use of a cropping system that includes close-growing crops and deep-rooted legumes, the use of crop residue, and the use of commercial fertilizer and manure help maintain and improve fertility and tilth. Land leveling, irrigating on the contour, and irrigating with a sprinkler system supplemented with terraces help reduce erosion. Underground pipe and gated pipe prevent loss of water by evaporation and deep percolation. Capability units IIIe-1 dryland, IIe-3 irrigated; Limy Upland range site; Silty Upland windbreak suitability group.

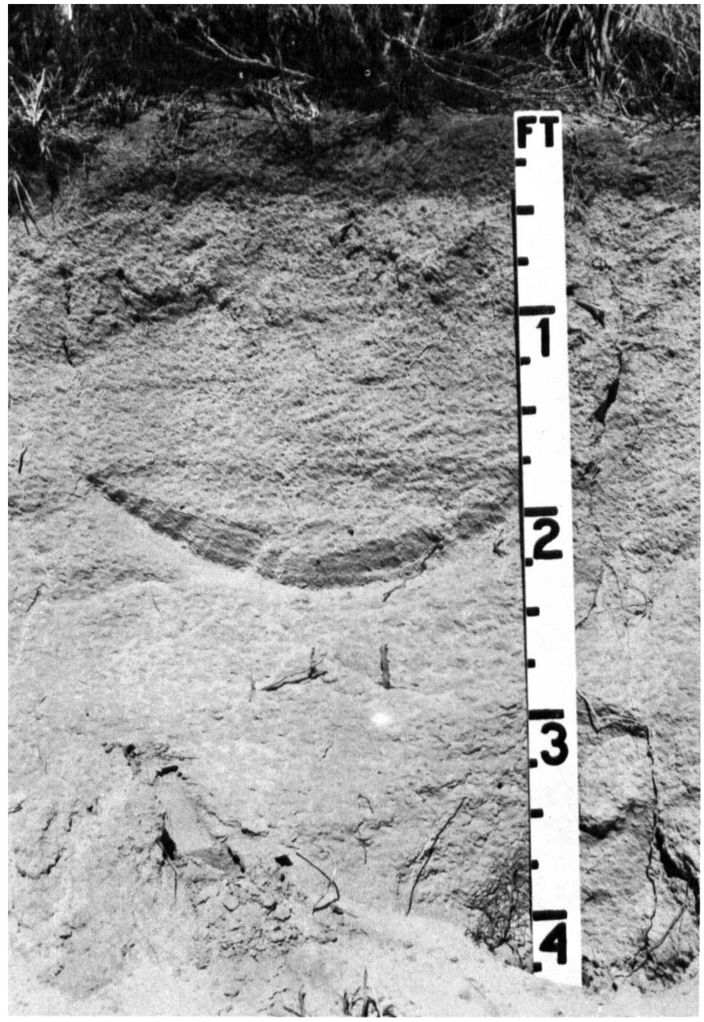



*Figure 15.*—**Profile of a Tivoli fine sand. The thin, dark-colored surface layer is underlain by sand.**

**Us—Uly silt loam, 3 to 6 percent slopes.** This sloping soil is on convex side slopes adjacent to the deeper drainageways in the uplands. It has a profile similar to the one described as representative of the series, but the surface layer and subsoil are slightly thinner and has calcareous material at a shallower depth. Included in mapping were small areas of eroded Uly soils and Mansic soils.

Most of this Uly soil is still in native short grasses and used for grazing. In cultivated areas wheat and grain sorghum are the main crops. Runoff is excessive because of slope, and water erosion is a serious hazard. Soil blowing is also a hazard unless the soil is protected by vegetation or crop residue. Terracing, contour farming, and keeping crop residue on the surface help control runoff and erosion and conserve moisture.

No areas of this sloping soil in the county are now irrigated. If the soil were irrigated, good management would provide control of erosion, efficient use of water, and maintenance of fertility and tilth. The use of a cropping system that includes close-growing crops and deep-rooted legumes,

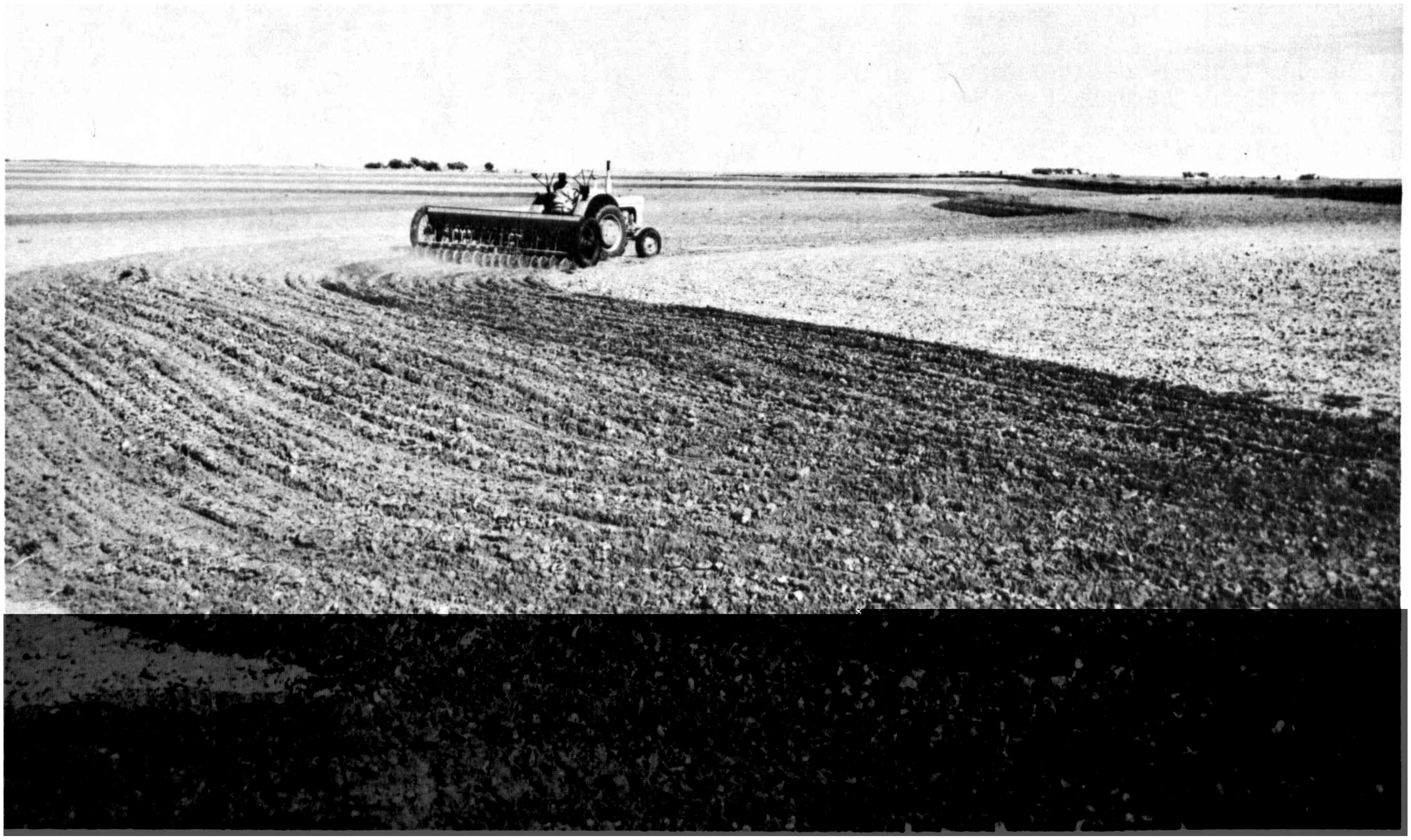


*Figure 16.*—Wheat being sown on the contour on Uly silt loam, 1 to 3 percent slopes.

the use of crop residue, and the use of commerical fertilizer and manure help maintain and improve fertility and tilth. Land leveling, irrigating on the contour, and irrigating with a sprinkler system supplemented with terraces help reduce erosion. Underground pipelines help to eliminate ditches and to reduce the loss of water. Capability units IIIe-1 dryland, IIIe-1 irrigated; Loamy Upland range site; Silty Upland windbreak suitability group.

**Ut—Uly silt loam, 3 to 6 percent slopes, eroded.** This sloping soil is on long, sloping side slopes adjacent to the deeper drainageways and on convex side slopes along tributaries of Crooked Creek. In about 35 percent of the area, the soil has been so eroded that the surface layer is thinner, is lighter colored, and has calcareous material at a shallower depth than the surface layer in the profile described as representative of the series. Included in mapping were areas of Mansic soils.

Most of this Uly soil is cultivated. Wheat and grain sorghum are the main crops. In calcareous areas grain sorghum shows signs of chlorosis during early growth. Runoff is excessive because of slope, and water erosion is a serious hazard. Soil blowing is also a serious hazard unless the soil is protected by vegetation or crop residue. Terracing, contour farming, and keeping crop residue on the surface conserve moisture and prevent further erosion.

Although this sloping is not well suited to irrigation, some areas are irrigated. Good management of this soil under irrigation must provide control of erosion, efficient use of water, and maintenance of fertility and tilth. The use of a cropping system that includes close-growing crops and deep-rooted legumes, the use of crop residue, and the use of commercial fertilizer and manure help maintain and improve fertility and tilth. Land leveling, irrigating on the contour, and irrigating with a sprinkler system supplemented with terraces help reduce erosion. Underground pipelines help to eliminate ditches and to reduce the loss of water. Capability units IVe-2 dryland, IIIe-1 irrigated; Limy Upland range site; Silty Upland windbreak suitability group.

## Wann Series

The Wann series consists of deep, somewhat poorly drained, nearly level soils on the flood plains of Crooked Creek and the Cimarron River. These soils formed in stratified calcareous alluvium. The native vegetation is mid and tall grasses.

In a representative profile the surface layer is grayish-brown, calcareous loam about 13 inches thick. The underlying material is light-gray, calcareous fine sandy loam that has faint, yellowish-brown mottles.

Permeability is moderately rapid, and available water capacity is high. Fertility is medium. Runoff is slow. These soils have a fluctuating water table. They are occasionally subject to flooding.

Most of the acreage is in native grasses and used for range. Some areas are cultivated.

Representative profile of Wann loam, in grassland, about

*Figure 17.*—Irrigated alfalfa growing on Yahola sandy loam. The Otero-Mansic complex, 5 to 25 percent slopes, is in the background.

660 feet north and 90 feet west of the southeast corner of sec. 22, T. 32 S., R. 28 W.:

A1—0 to 13 inches, grayish-brown (10YR 5/2) loam, very dark grayish

Good management of irrigated areas includes maintenance and improvement of fertility, efficient use of irrigation water, and control of salinity. The use of a cropping system brown, calcareous sandy loam about 5 inches thick. The underlying material is light brownish-gray and very pale brown, calcareous sandy loam.

Permeability is moderately rapid, and available water capacity is moderate. Fertility is medium. Runoff is slow.

Most of the acreage is in native grasses. Some areas are cultivated. Most of the native grasses have been grazed so close that the tall grasses have been grazed out.

and irrigation farming. Next, the range management, windbreak management, wildlife management, and engineering uses of the soils are described.

## Capability Grouping

Some readers, particularly those who farm on a large scale, may find it practical to use and manage alike some of

Class I. Soils have few limitations that restrict their use. The low rainfall in Meade County restricts this class to irrigated soils.

Unit I-1. Deep, nearly level, well-drained soils that have a surface layer of loam, silt loam, clay loam, or silty clay loam and a subsoil of silty clay loam or clay loam.

Class II. Soils have some limitations that reduce the choice of plants or require moderate conservation practices.

Subclass IIe. Soils on uplands that are subject to moderate erosion unless protected.

Unit IIe-1. Deep, gently sloping, well-drained soils that have a surface layer of loam, silt loam, or silty clay loam and a subsoil of silty clay loam or clay loam.

Unit IIe-2. Deep, nearly level and gently sloping or gently undulating, well-drained soils that have a surface layer of fine sandy loam and clay loam and a subsoil of fine sandy loam, clay loam, or sandy clay loam.

Unit IIe-3. Deep, gently sloping, well-drained soils that have a surface layer of silt loam or clay loam and a subsoil of calcareous silty clay loam or clay loam.

Subclass IIw. Soils on flood plains that have moderate limitations because of excess water.

Unit IIw-1. Deep, nearly level, somewhat poorly drained soils that have a surface layer and subsoil of clay loam.

Unit IIw-2. Deep, nearly level, somewhat poorly drained soils that have a surface layer of loam and a subsoil of fine sandy loam.

Subclass IIs. Soils on uplands that have moderate limitations because of limited moisture capacity or slow permeability.

Unit IIs-1. Deep, nearly level to gently sloping, well-drained soils that have a surface layer and subsoil of fine sandy loam or sandy loam.

Unit IIs-2. Deep, nearly level, well-drained soils that have a surface layer of silty clay loam and a subsoil of silty clay.

Subclass IIc. Soils on uplands that are limited only by climate.

Unit IIc-1. Deep, nearly level, well-drained soils that have a surface layer of loam, silt loam, clay loam, or silty clay loam and a subsoil of silty clay loam or clay loam.

Unit IIc-2. Deep, nearly level, well-drained soils that have a surface layer of silt loam and a subsoil of silty clay loam.

Class III. Soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Subclass IIIe. Soils on uplands that are subject to severe erosion if they are cultivated and not protected.

Unit IIIe-1. Deep, gently sloping and sloping, well-drained and somewhat excessively drained soils that have a surface layer of calcareous silt loam, clay loam, and silty clay loam and a subsoil of calcareous silty clay loam or clay loam.

Unit IIIe-2. Deep, nearly level to gently rolling, well-drained soils that have a surface layer and subsoil of loamy fine sand.

Unit IIIe-3. Deep, gently rolling, well-drained soils that have a surface layer and subsoil of fine sandy loam.

Unit IIIe-4. Deep, gently sloping, well-drained soils that have a surface layer and subsoil of sandy loam.

Subclass IIIw. Soils on flood plains that have severe limitations because of excess water.

Unit IIIw-3. Moderately deep, nearly level, somewhat poorly drained soils that have a surface layer and subsoil of clay loam and a substratum of sand.

Class IV. Soils have very severe limitations that restrict the choice of plants, require very careful management, or both.

Subclass IVe. Soils on uplands that are subject to very severe erosion if they are cultivated and not protected.

Unit IVe-1. Deep, gently rolling, well-drained soils that have a surface layer and subsoil of loamy fine sand.

Unit IVe-2. Deep, sloping, well-drained, eroded, calcareous soils that have a surface layer and subsoil of clay loam or silty clay loam.

Unit IVe-3. Deep, gently rolling, well-drained soils that have a surface layer and subsoil of fine sandy loam.

Unit IVe-4. Deep, gently rolling to rolling, well-drained soils that have a surface layer of fine sand and a subsoil of loamy fine sand.

Subclass IVw. Soils on flood plains that have very severe limitations because of excess water. None in Meade County.

Subclass IVs. Soils that have very severe limitations because of very slow permeability or poor tilth.

Unit IVs-1. Deep, nearly level, poorly drained, compact clay soils.

Class V. Soils are subject to little or no erosion but have other characteristics that limit their use largely to pasture or range, woodland, or wildlife habitat.

Subclass Vw. Soils on flood plains that have severe limitations because of excess water.

Unit Vw-1. Moderately deep to deep, nearly level and channeled, frequently flooded soils that have a surface layer of clay loam or loamy fine sand and underlying material of loamy fine sand or sand.

Class VI. Soils have severe limitations that make them unsuited to cultivation and restrict their use largely to pasture or range, woodland, or wildlife habitat.

Subclass VIe. Soils that have severe limitations, chiefly because of hazard of erosion unless protective cover is maintained.

Unit VIe-1. Deep, strongly sloping, well-drained soils that have a surface layer and subsoil of clay loam.

Unit VIe-2. Deep, gently sloping to rolling loamy fine sands.

Unit VIe-3. Deep, strongly sloping, somewhat excessively drained soils that have a surface layer and subsoil of fine sandy loam.

Unit VIe-4. Shallow and deep, strongly sloping, well-drained and somewhat excessively drained soils that are calcareous loam over caliche.

Unit VIe—5. Strongly sloping to steep, calcareous sandy loams and clay loams.

Subclass VIw. Soils that have severe limitations because of excess water and are generally unsuitable for cultivation.

Unit VIw-1. Deep, nearly level and channeled, frequently flooded loamy soils.

Unit IVw-2. Deep, poorly drained, compact clay soils in upland depressions.

Class VII. Soils have very severe limitations that make them unsuitable for cultivation and restrict their use largely to range, woodland, or wildlife habitat.

Subclass VIIe. Soils that have very severe limitations because of the hazard of soil blowing, the low available water capacity, and the low natural fertility.

Unit VIIe-1. Deep, excessively drained, fine sands on hills.

Subclass VIIs. Soils that have very severe limitations because of steep slopes and rough, broken topography.

Unit VIIs-1. Steep, rough, broken, eroded material and some shallow soils.

Class VIII. Soils and landforms have limitations that preclude their use for commercial crops and restrict their use to recreation, wildlife habitat, water supply, or esthetic purposes. (None in Meade County.)

grown on bottom land, but some is grown on uplands. Forage sorghum is also grown. The sequence of crops that are grown affects the combination of practices needed on a particular soil. Close-growing crops, such as wheat, provide more protection for the soil than row crops.

***Predicted yields of dryland crops***

The predicted average yields per acre that can be expected for the principal dryland crops grown in Meade County are shown in table 2. These yields do not apply to any specific field in any particular year. Rather, they indicate what can be expected as an average yield over a period of years. The estimates in the table were made on the basis of information obtained from local farmers, various farm agencies, demonstration plots, and research data.

Only soils that are commonly used for crops are listed in table 2. The predicted yields are for a high level of management. Such management includes the following:

1. Crop varieties suited to the area.
2. Proper seeding rates and suitable and timely methods of planting and harvesting.
3. Full and timely use of practices for controlling weeds, diseases, and insects.
4. Timely tillage.
5. Fertility program based on requirements for opti-

ways, stubble-mulch tillage, and summer fallow to conserve moisture and control runoff.

7. Use of a cropping system and management of crop residue to control water erosion and soil blowing and to keep soil in good physical condition.

## Managing Irrigated Soils [3]

The factors to be considered in planning an irrigation system are (1) the characteristics and properties of the soil, (2) the quality and quantity of irrigation water available, (3) the crops to be irrigated, and (4) the type of system to be used for irrigation (fig. 18). It is especially important to know the quality of the irrigation water so that the long-time effect of irrigation on the soil can be evaluated. All natural waters used for irrigation contain some soluble salts. If water of poor quality is used on a soil that is slowly permeable, harmful salts are likely to accumulate in the soil if some leaching is not done. This requires an application of water in excess of the needs of the crops so that some of the water passes through the root zone.

Some of the soil factors that are important to irrigation are depth, available water capacity, permeability, drainage, slope, and susceptibility to stream overflow. All of these must be considered in designing the irrigation system. The frequency of irrigation depends on the requirements of the crop and the available water capacity of the soil. The available water capacity is determined mainly by the depth and texture of the soil. Permeability affects the rate at which water enters the soil and, also, the internal drainage. The rate of water intake is also affected by the condition of the surface layer.

The soil survey has determined the characteristics of

*Figure 18.*—Preirrigation prior to seeding on a freshly worked field. The soil is Harney silt loam, 0 to 1 percent slopes.

5. Seeding at a rate that insures a maximum plant population.
6. Properly applied irrigation water.

*Figure 19.*—Irrigated grain sorghum on Spearville silty clay loam, 0 to 1 percent slopes.

In the absence of abnormal disturbances, a range site supports a mixture of native plants best adapted to the soil and the environmental conditions of the site. This plant cover is called the natural potential, or climax, plant community. The climax vegetation is generally the most productive combination of range plants that a site is capable of growing under natural conditions.

Under proper grazing management, a mixture of plants representative of the climax community can be maintained indefinitely. If a site is subjected to continuous excessive grazing, however, the climax cover is altered. Plants within the climax vegetation are not equally palatable to grazing animals. Livestock graze selectively, continually seeking the more palatable plants. Unless grazing is regulated, these preferred plants become overgrazed. All range plants are placed in three categories: decreasers, increasers, and invaders. These categories are based on response of the plants to continuous overgrazing.

Decreaser plants are the most palatable plants in the climax community. They decrease in abundance if the site is subject to continued excessive grazing. Increaser plants are less palatable plants in the climax community that increase in abundance if the site is continually overgrazed. Under prolonged excessive grazing, decreaser plants are largely eliminated and increaser plants may dominate the site. Invader plants are not present in the climax plant community for the site. They invade as a result of various kinds of disturbances on the site, such as prolonged excessive grazing, drought, fire, and infestations of rodents and insects.

Changes in the vegetation within each range site can be determined by comparing the present vegetation to the climax vegetation for that site. This is expressed as *range condition.* It provides a measure of the changes that have taken place in the plant cover and provides a basis for predicting the amount of improvement that can be expected in

TABLE 3.—*Predicted average yields per acre of the principal irrigated crops on soils most commonly irrigated*

| Soil | Wheat | Grain sorghum | Forage sorghum | Alfalfa | Corn |
|---|---|---|---|---|---|
| | *Bu* | *Bu* | *Tons* | *Tons* | *Bu* |
| Harney silt loam, 0 to 1 percent slopes | 50 | 115 | 22 | 6 | 120 |
| Satanta loam, 0 to 1 percent slopes | 50 | 115 | 24 | 6 | 120 |
| Spearville silty clay loam, 0 to 1 percent slopes | 45 | 100 | 21 | 6 | 105 |
| Uly silt loam, 0 to 1 percent slopes | 50 | 115 | 23 | 6 | 120 |

the plant community from proper management.

Four range condition classes are recognized. A range site is in *excellent* condition if 76 to 100 percent of the climax vegetation is present on the site; in *good* condition if 51 to 75 percent is present; in *fair* condition if 26 to 50 percent is present; and in *poor* condition if 0 to 25 percent is present.

Major changes or trends in range vegetation take place so gradually that they are often overlooked unless the operator is familiar with the characteristics of the range sites and the response of different kinds of plants to grazing. Sometimes, during periods of favorable rainfall, plant growth is stimulated, giving the appearance of range improvement when actually the long-term trend is toward less palatable grasses and lower production. On the other hand, a dry season may result in overgrazing of a healthy range and cause it to appear degraded when actually the setback is only seasonal or temporary.

### *Descriptions of range sites*

On the following pages the range sites of Meade County are described and the climax plants and principal invaders on the sites are named. Also shown is an estimate of the potential annual yield of air-dry herbage for each site if it is in excellent condition. The soils in each site can be determined by referring to the Guide to Mapping Units at the back of this soil survey.

#### CLAY UPLAND RANGE SITE

This range site consists of soils in the Missler and Spearville series. These are deep soils that have a surface layer of silty clay loam and a subsoil of silty clay or silty clay loam. The density of these soils restricts the downward movement of water, making this site droughty. Careful management of the soils generally maintains the site in a productive state.

If this site is in excellent condition, such decreasers as side-oats grama and western wheatgrass make up as much as 70 percent of the total production, and increasers account for the rest. The common decreaser plants growing on this site are side-oats grama, western wheatgrass, big bluestem, slimflower scurf-pea, and dotted gayfeather. western ragweed, and vine-mesquite. The common invaders are Kentucky bluegrass, silver bluestem, windmillgrass, tumblegrass, kochia, common sunflower, and annuals.

If this site is in excellent condition, the average annual yield of air-dry herbage is about 4,800 pounds per acre. Production ranges from 6,000 pounds in favorable years to 3,800 pounds in unfavorable years. This potential production makes this one of the better range sites in the county.

#### LOAMY TERRACE RANGE SITE

Only Roxbury silt loam is in this range site. This is a deep soil that has a surface layer of silt loam and a subsoil of silty clay loam. It receives some runoff from nearby uplands.

If this site is in excellent condition, such decreasers as big bluestem and indiangrass make up as much as 80 percent of the total production, and increasers account for the rest. The common decreaser plants growing on this site are switchgrass, big bluestem, indiangrass, little bluestem, Canada wildrye, and ashy goldenrod. Increasers are western wheatgrass, side-oats grama, blue grama, buffalograss, tall dropseed, western ragweed, heath aster, and vine-mesquite. The common invaders are silver bluestem, windmillgrass, tumblegrass, and other annuals.

If this site is in excellent condition, the average annual yield of air-dry herbage is about 3,500 pounds per acre. This production ranges from 4,500 pounds in favorable years to 2,500 pounds in unfavorable years. This site generally produces more forage than the Loamy Upland range sites and less than the Loamy Lowland range site.

#### LOAMY UPLAND RANGE SITE

This range site consists of soils in the Harney, Satanta, and Uly series. These are deep soils that have a surface layer of silt loam or loam and a subsoil of silty clay loam or clay loam.

If this site is in excellent condition, such decreasers as big bluestem and little bluestem make up as much as 60 percent of the total production, and increasers account for the rest. The common decreaser plants growing on this site

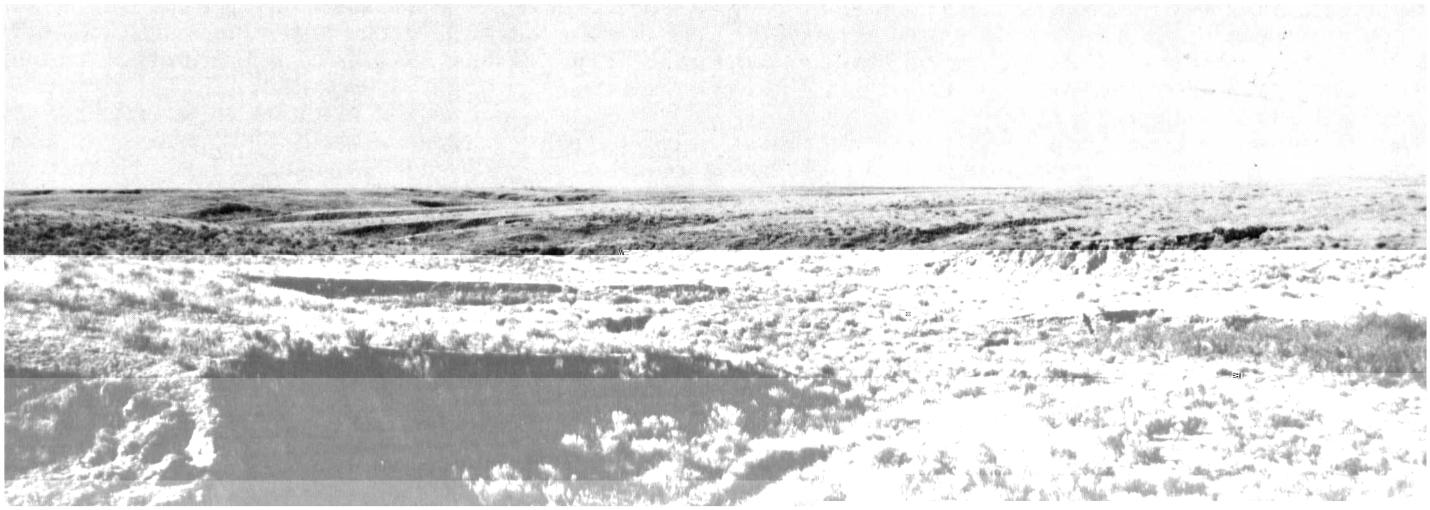


*Figure 20.*—Typical area of a Mansic clay loam on Limy Upland range site.

Increasers are blue grama, hairy grama, buffalograss, tall dropseed, western wheatgrass, broom snakeweed, and western ragweed. The common invaders are silver bluestem, tumblegrass, windmillgrass, and annuals.

If this site is in excellent condition, the average annual yield of air-dry herbage is about 2,500 pounds per acre. Production ranges from 4,000 pounds per acre in favorable years to 1,000 pounds in unfavorable years.

Generally, this site is in fair condition and blue grama and buffalograss provide most of the forage. Broom snakeweed increases during periods of drought and overuse.

#### SANDS RANGE SITE

This range site consists of soils in the Likes and Pratt series. The Likes soil has a surface layer of loamy sand and underlying material of loamy sand or fine sand. The Pratt soil has a surface layer of loamy fine sand or sand and subsoil of loamy fine sand or loamy sand. Maintaining an adequate cover to protect these soils from soil blowing is the main concern of management (fig. 21).

sand lovegrass, giant sandreed, and lemon scurf-pea. Increasers are side-oats grama, blue grama, hairy grama, western ragweed, sand sagebrush, purple lovegrass, sand dropseed, and Scribners panicum. The common invaders are showy gaillardia, six-weeks three-awn, false buffalograss, and annual eriogonum.

If this site is in excellent condition, the average annual yield of air-dry herbage is about 3,000 pounds per acre. Production ranges from 3,500 pounds in favorable years to 2,000 pounds in unfavorable years. In many areas of this site, sand sagebrush is a concern and requires special management (fig. 22).

#### SANDY LOWLAND RANGE SITE

Only Lincoln soils are in this range site. These are deep soils that have a surface layer of loamy fine sand or sand and are underlain by sand (fig. 23). They sometimes receive additional water in the form of flooding.

If this site is in excellent condition, such decreasers as sand bluestem and indiangrass make up as much as 90 perbrush, pricklypear, and vine-mesquite. The common invaders are windmillgrass, tumblegrass, annual brome, cocklebur, and other annuals.

If this site is in excellent condition, the average annual yield of air-dry herbage is about 4,000 pounds per acre. Production ranges from 4,500 pounds in favorable years to 3,500 pounds in unfavorable years.

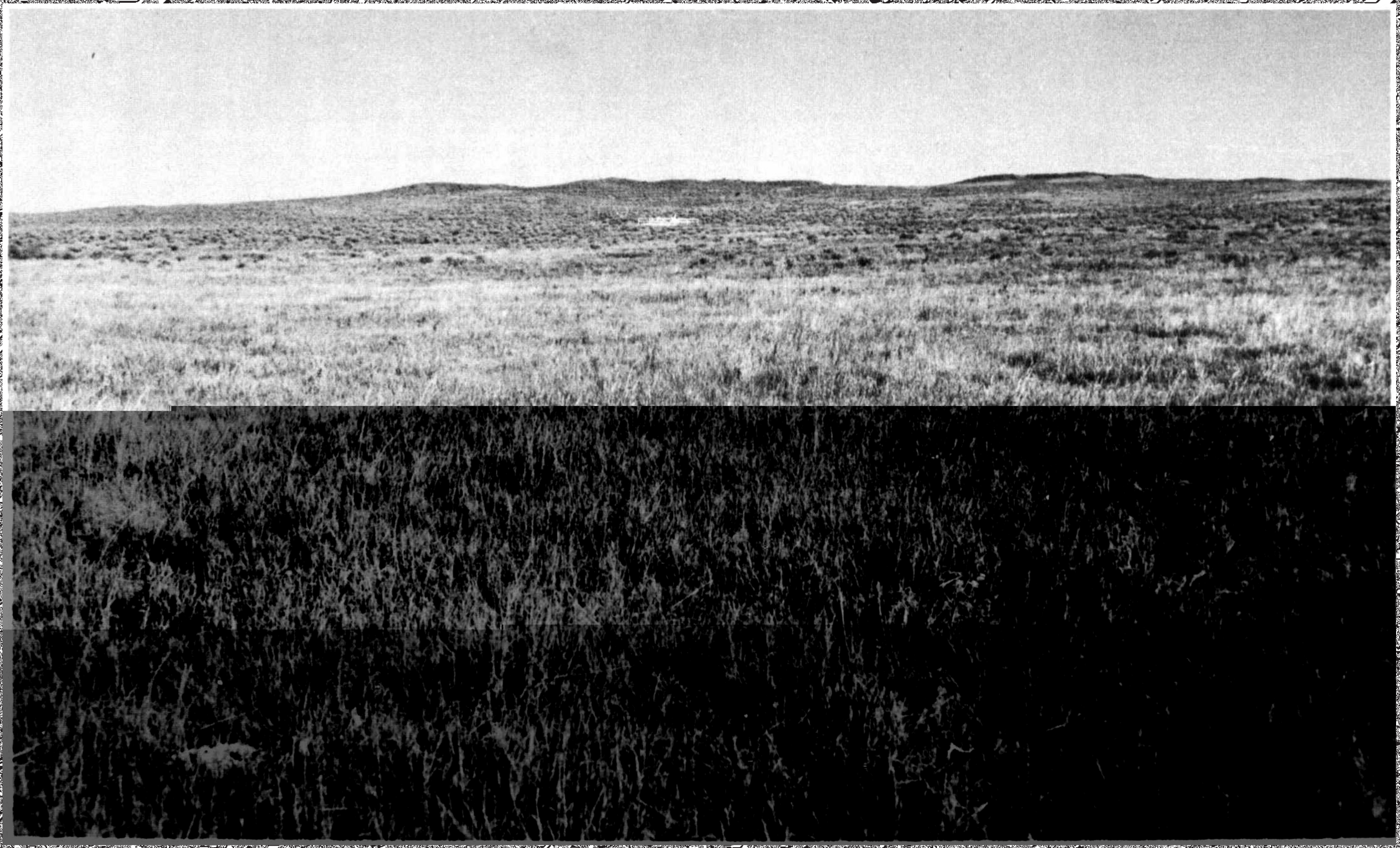
#### SANDY TERRACE RANGE SITE

Only Yahola sandy loam is in this range site. This is a

#### SANDY RANGE SITE

This range site consists of soils in the Manter, Satanta, and Otero series. The Manter and Satanta soils have a surface layer of fine sandy loam and a subsoil of fine sandy loam or sandy clay loam. The Otero soil is fine sandy loam throughout.

If this site is in excellent condition, such decreasers as sand bluestem make up as much as 80 percent of the total production, and increasers account for the rest. The common decreaser plants growing on this site are sand



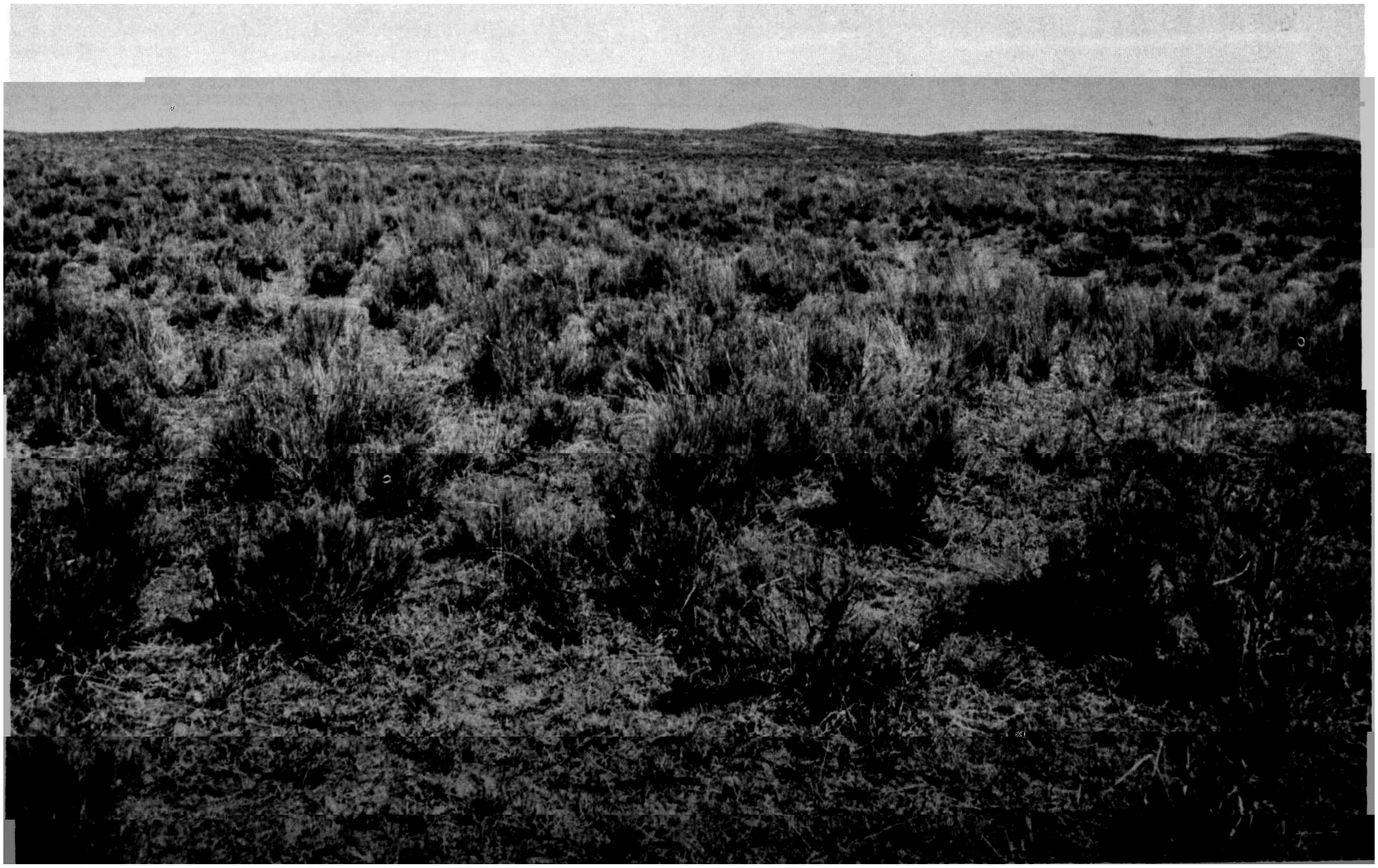


*Figure 22.*—Sand sagebrush on Likes loamy sand.

75 percent of the total production, and increasers account for the rest. The common decreaser plants growing on this site are sand bluestem, little bluestem, indiangrass, prairie sandreed, blowoutgrass, and sand lovegrass. Increasers are sand dropseed, and paspalum, blue grama, hairy grama, sand sagebrush, and perennial three-awn. The common invaders are false buffalograss, annual three-awn, red lovegrass, sandbur, common sunflower, and other annuals.

If this site is in excellent condition, the average annual yield of air-dry herbage is about 1,800 pounds per acre. Production ranges from 2,300 pounds in favorable years to 1,300 pounds in unfavorable years.

#### SHALLOW LIMY RANGE SITE

This range site consists of Canlon soils and Rough broken land. These soils are shallow over caliche. In many places the rough, broken topography makes the site difficult for livestock to utilize (fig. 24).

If this site is in excellent condition, such decreasers as little bluestem and side-oats grama make up as much as 70 percent of the total production, and increasers account for the rest. The common decreaser plants growing on this site are little bluestem, indiangrass, big bluestem, Canada wildrye, switchgrass, western wheatgrass, prairie-clover, and Jerseytea. Increasers are blue grama, hairy grama, buffalograss, side-oats grama, broom snakeweed, purple three-awn, and babywhite aster. Annuals are the common invaders.

If this site is in excellent condition, the average annual yield of air-dry herbage is about 1,400 pounds per acre. Production ranges from 1,600 pounds in favorable years to 800 pounds in unfavorable years.

#### SUBIRRIGATED RANGE SITE

This range site consists of soils in the Kanza, Leshara, Lesho, and Wann series. These are deep to moderately deep soils that have a surface layer of clay loam or loam and underlying material of clay loam, fine sandy loam, or sand. They receive extra moisture from floods and from a high water table.

If this site is in excellent condition, such decreasers as big bluestem, indiangrass, switchgrass, and prairie cordgrass make up 90 percent of the total production (fig. 25), and increasers account for the rest. The common decreaser plants growing on this site are big bluestem, indiangrass, switchgrass, eastern gamagrass, little bluestem, prairie cordgrass, and Illinois bundleflower. Increasers are side-oats grama, western wheatgrass, blue grama, western ragweed, buffalograss, and foxtail barley. The common invaders are silver bluestem, windmillgrass, annual brome, common sunflower, and other annuals.

If this site is in excellent condition, the average annual yield of air-dry herbage is about 7,500 pounds per acre. The subirrigated condition of this site reduces the effect of climate on production.

## Windbreak Management

There are no large areas of woodland in Meade County. The flood plains of Crooked Creek and the Cimarron River support a sparse, mixed stand of eastern cottonwood, tamarisk, and other trees and shrubs. These trees and shrubs

windbreak suitability groups. The data in table 4 were obtained from the Soil Survey Reports of Finney, Grant, Haskell, Kearney, and Logan Counties.

More information about the planting and care of trees and shrubs in farmstead windbreaks can be obtained from the local representative of the Soil Conservation Service or from the county agent.

## Wildlife Management [5]

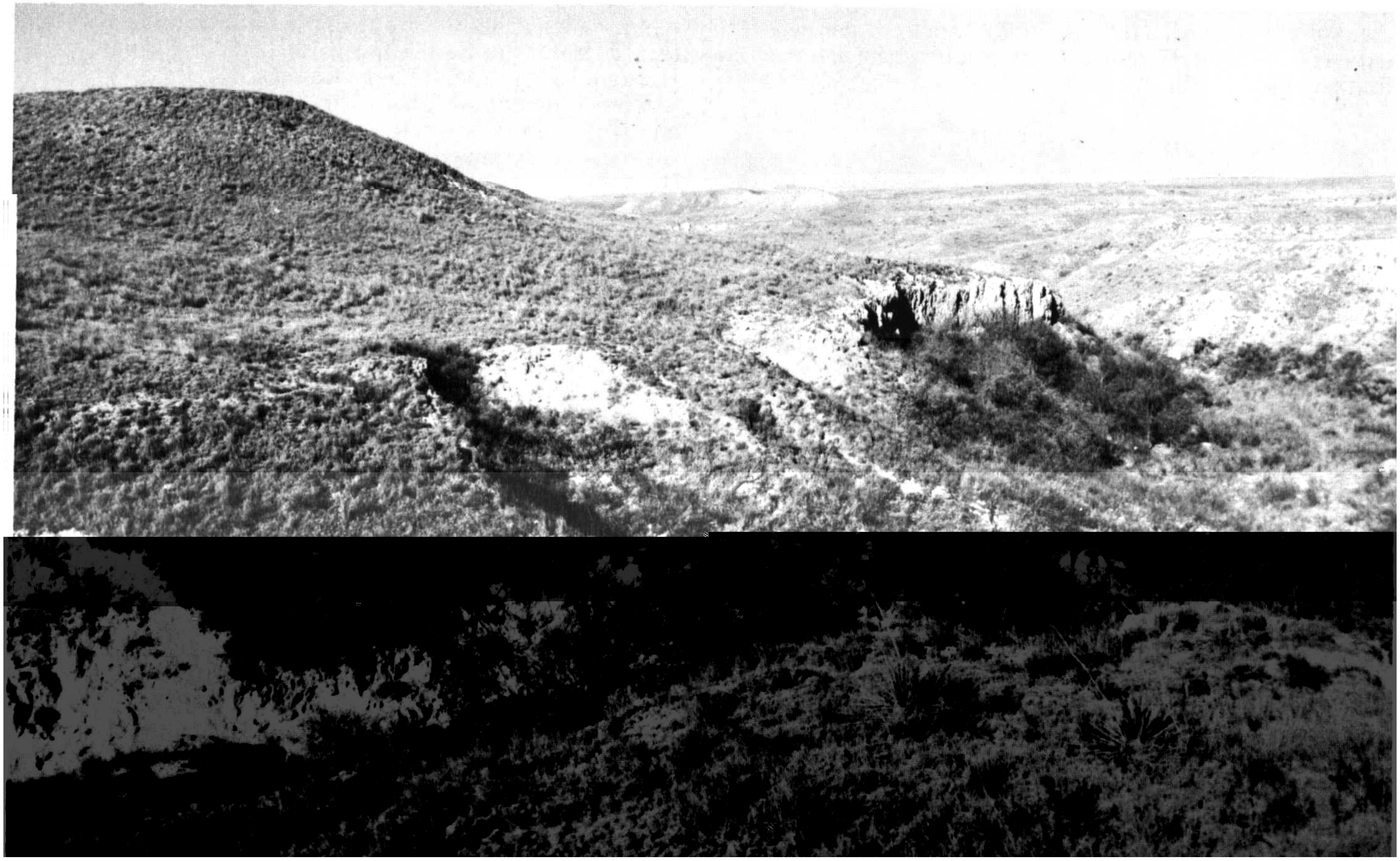


*Figure 24.*—**Steep areas and caliche outcrops characterize the Canlon soils on the Shallow Limy range site. These steep areas are especially difficult to manage.**

processes that wipe out one organism may very well benefit another.

Wildlife management, if it is to serve the vast numbers and diverse interests of people, must be intensive and purposeful. A balance of values must be established as we fashion our way of life for the future.

Wildlife responds to the differences in soils. This response is favorable on suitable soils and poor on soils that are not suitable to meet the needs of the animal concerned. Therefore, each soil is rated on the basis of its capacity to furnish grain and seed crops, grasses and legumes, wild herbaceous upland plants, hardwood woody plants, conif-

TABLE 4.—*Trees and shrubs suitable for planting, by windbreak suitability groups*

[Height figures are estimated for each species at an age of 10 years]

| Suitable trees and shrubs | Windbreak suitability groups | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Silty Upland | | Sandy Upland | | Subirrigated Lowland | | Lowland | |
| | Dryland | Irrigated | Dryland | Irrigated | Dryland | Irrigated | Dryland | Irrigated |
| | *Feet* | *Feet* | *Feet* | *Feet* | *Feet* | *Feet* | *Feet* | *Feet* |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

erous woody plants, wetland food and cover plants, shallow water developments, and ponds. Specific habitat elements are rated for each kind of soil in the county. These are used to approximate a general soil suitability rating for each kind of soil for openland, wetland, and rangeland wildlife, as indicated in table 5.

Openland wildlife are birds and mammals of croplands, pastures, meadows, lawns, and areas overgrown with grasses, herbs, shrubs, and vines. They include bobwhite quail, pheasant, meadowlark, field sparrow, killdeer, cottontail rabbit, red fox, and woodchuck.

Wetland wildlife are birds and mammals of swampy, marshy, or open-water areas. They include ducks, geese, herons, shore birds, rails, kingfishers, muskrat, and beaver (fig. 26).

Rangeland wildlife are birds and mammals of natural range. They include antelope, white-tailed deer, muledeer, bison, lesser prairie chicken, coyote, badger, jackrabbit, and prairie dog.

*Figure 25.*—An area of Kanza soils in the Subirrigated range site. This hayland meadow produces dominantly tall grasses, including eastern gamagrass in excellent condition.

## Engineering Uses of the Soils [6]

This section is useful to those who need information about soils used as structural material or as foundations upon which structures are built. Among those who can benefit from this section are planning commissions, town and city managers, land developers, engineers, contractors,

TABLE 5.—*Suitability*

| Soil series and map symbols | Elements of wildlife habitat | | | | |
|---|---|---|---|---|---|
| | Grain and seed crops | Domestic grasses and legumes | Wild herbaceous plants | Hardwood trees | Coniferous plants |
| Alluvial land, loamy: An. | Poor | Poor | Fair | Good | Good |
| Blown-out land: Bo | Very poor | Very poor | Very poor | Very poor | Very poor |
| Campus: Cc. For Canlon part, see Canlon series. | Poor | Fair | Good | Poor | Poor |
| Canlon. Mapped only in complex with Campus soils. | Poor | Poor | Poor | Poor | Poor |
| Harney: Ha, Hb, Hc | Good | Good | Good | Fair | Fair |
| Kanza: Kz | Poor | Fair | Fair | Fair | Fair |
| Leshara: Le | Fair | Good | Fair | Fair | Fair |

*of the soils for wildlife*

| Elements of wildlife habitat—*Continued* | | | Kinds of wildlife | | |
|---|---|---|---|---|---|
| Shrubs | Wetland plants | Shallow-water | Openland | Wetland | Rangeland |

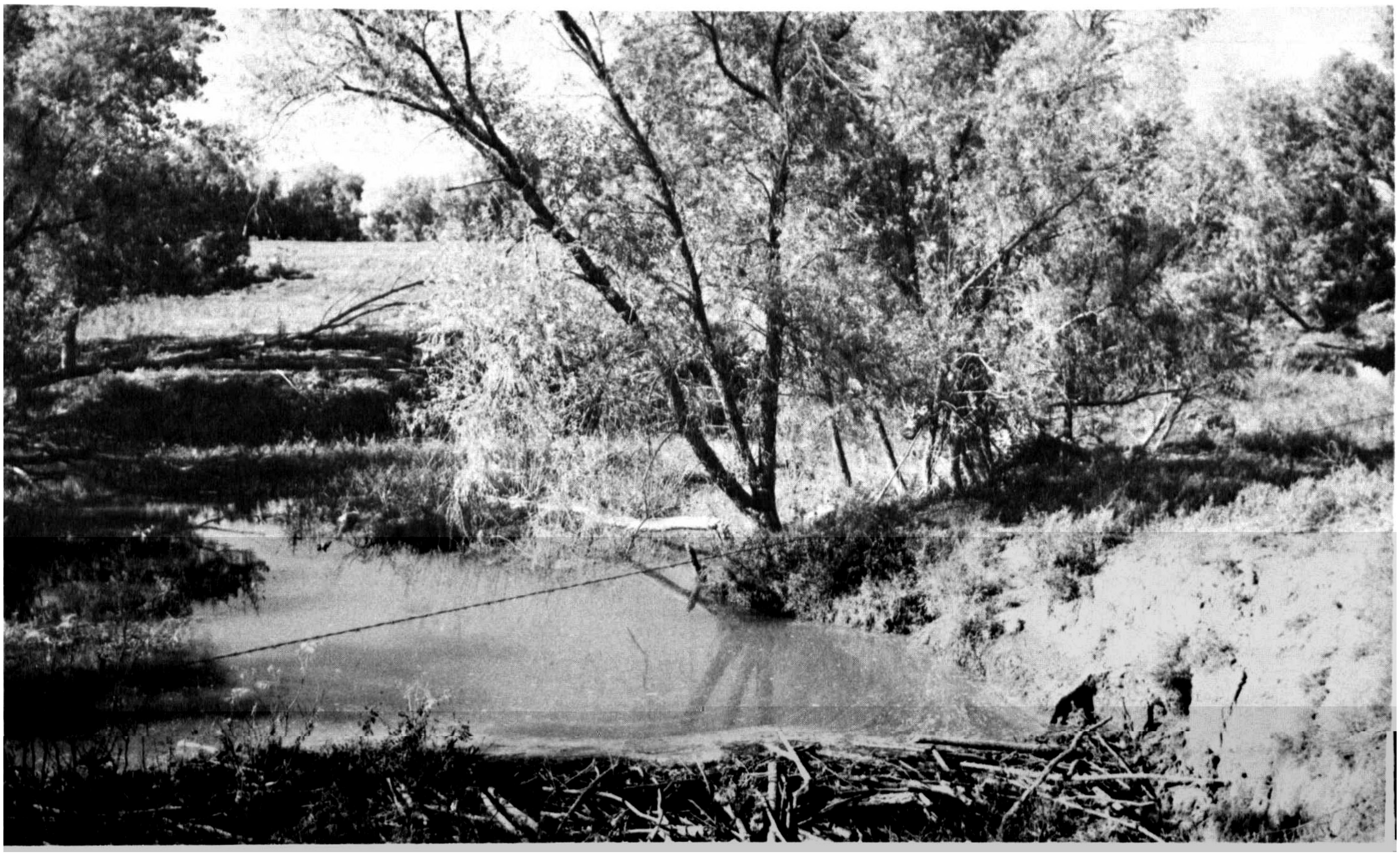


*Figure 26.*—**Beaver dam on Spring Creek.**

TABLE 6.—*Estimated soil properties*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in such mapping appear in the first column of this table. The symbol >

| Soil series and map symbols | Depth to— Bedrock | Depth to— Seasonal high water table | Depth from surface of typical profile | USDA texture | Classification: Unified | Classification: AASHTO | Percentage less than 3 inches passing sieve— No. 4 (4.7 mm) | Percentage less than 3 inches passing sieve— No. 10 (2.0 mm) |
|---|---|---|---|---|---|---|---|---|
| | *Feet* | *Feet* | *Inches* | | | | | |
| Alluvial land, loamy: An. Too variable for valid estimates. | | | | | | | | |
| Blown-out land: Bo. Too variable for valid estimates. | | | | | | | | |
| *Campus: Cc. For Canlon part, see Canlon series. | >6 | >6 | 0-7 | Clay loam | ML, CL | A-4, A-6 | 95-100 | 95-100 |
| | | | 7-60 | Clay loam | CL, ML | A-4, A-6 | 98-100 | 90-100 |
| Canlon. Mapped only in complex with Campus soils. | 1-2 | >6 | 0-12 | Loam | ML, CL | A-6, A-4 | 80-95 | 70-90 |
| | | | 12-60 | Caliche. | | | | |
| Harney: Ha, Hb, Hc | >6 | >6 | 0-6 | Silt loam | ML, CL | A-4, A-6 | 100 | 100 |
| | | | 6-15 | Silty clay loam | CL | A-6, A-7-6 | 100 | 100 |
| | | | 15-20 | Silty clay loam | CH, CL | A-7-6 | 100 | 100 |
| | | | 20-29 | Silty clay loam | CL | A-7-6, A-6 | 100 | 100 |
| | | | 29-60 | Silt loam | ML, CL | A-4, A-6 | 100 | 100 |

particles coarser than sand, an appropriate modifier is added, as for example, "gravelly loamy sand."

Shrink-swell potential refers to the relative change in volume to be expected of soil material with changes in

TABLE 6.—*Estimated soil properties*

| Soil series and map symbols | Depth to— | | Depth from surface of typical profile | USDA texture | Classification | | Percentage less than 3 inches passing sieve— | |
|---|---|---|---|---|---|---|---|---|
| | Bedrock | Seasonal high water table | | | Unified | AASHTO | No. 4 (4.7 mm) | No. 10 (2.0 mm) |
| | *Feet* | *Feet* | *Inches* | | | | | |
| Kanza: Kz | >6 | 0-6 | 0-6 | Clay loam | CL | A-6 | 100 | 100 |
| | | | 6-40 | Loamy fine sand | SM | A-2-4 | 100 | 100 |
| Leshara: Le | >6 | 4-6 | 0-60 | Clay loam | ML, CL | A-4, A-6 | 100 | 100 |
| Lesho: Lh | >6 | 3-6 | 0-30 | Clay loam | CL | A-6, A-7-6 | 95-100 | 95-100 |
| | | | [illegible] | [illegible] | SP, SM | A-2-4 | 100 | 100 |

*significant to engineering*—Continued

| Percentage less than 3 inches passing sieve | | | | | | | | |
|---|---|---|---|---|---|---|---|---|

TABLE 7.—*Interpretations of*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in referring to other series that appear

| Soil series and map symbols | Degree and kind of limitation for— | | | | | | | Suitability as source of— |
|---|---|---|---|---|---|---|---|---|
| | Septic tank absorption fields | Sewage lagoons | Shallow excavations | Dwellings | Local roads and streets | Sanitary landfill: Trench type [1] | Sanitary landfill: Area type | Cover material for sanitary landfill |
| Alluvial land, loamy: An. Too variable for valid interpretations. | | | | | | | | |
| Blown-out land: Bo. Too variable for valid interpretations. | | | | | | | | |
| *Campus: Cc. For Canlon part, see Canlon series. | Slight if slope is less than 8 percent; moderate if 8 to 15. | Moderate: moderate permeability. | Slight if slope is less than 8 percent; moderate if 8 to 15. | Moderate with or without basements: low strength. | Moderate: low strength. | Moderate: clay loam texture. | Slight if slope is less than 8 percent; moderate if 8 to 15. | Poor: thickness of material. |
| Canlon. Mapped only [illegible] | Severe: depth to [illegible] | Severe: depth to [illegible] | Severe: depth to [illegible] | Severe with or without [illegible] | Severe: depth to [illegible] | Severe: depth to [illegible] | Moderate slope. | Poor: thickness of [illegible] |

*engineering properties of the soils*

such mapping units have different properties and limitations, and for this reason it is necessary to follow carefully the instructions for in the first column of this table]

| Suitability as source of—*Continued* | | | | Soil features affecting— | | | | |
|---|---|---|---|---|---|---|---|---|
| Topsoil | Sand and gravel | Road subgrade [2] | Road fill [2] | Highway location [2] | Pond reservoir areas | Embankments, dikes, and levees | Terraces, diversions, and waterways | Irrigation |
| Fair to poor: thickness of material; clay loam texture. | Unsuitable | Poor: low soil support. | Fair: fair shear strength. | Sloping to strongly sloping; high lime content. | Moderate permeability. | High compressibility; moderate stability. | Highly calcareous subsoil. | High available water capacity. |
| Poor: thickness of material. | Unsuitable | Poor: low soil support. | Fair: fair shear strength. | Sloping to strongly sloping; caliche at a depth of 10 to 20 inches. | Shallow over caliche. | Fair to good compaction characteristics; moderate shear strength. | Not applicable: shallow soils; sloping to strongly sloping. | Not applicable: very low available water capacity; shallow soils; sloping to strongly sloping. |
| Fair: surface layer 6 in- [illegible] | None | Fair: medium soil sup- [illegible] | Fair: fair shear [illegible] | Nearly level to gently [illegible] | Moderately slow per- [illegible] | Fair to poor [illegible] | Thick soil [illegible] | Thick soil [illegible] |

TABLE 7.—*Interpretations of engineering*

| Soil series and map symbols | Degree and kind of limitation for— | | | | | | | Suitability as source of— |
|---|---|---|---|---|---|---|---|---|
| | Septic tank | | | | Local roads | Sanitary landfill | | Cover material |

*properties of the soils*—Continued

| Suitability as source of—*Continued* | | | | Soil features affecting— | | | | |
|---|---|---|---|---|---|---|---|---|
| Topsoil | Sand and gravel | Road subgrade [2] | Road fill [2] | Highway location [2] | Pond reservoir areas | Embankments, dikes, and levees | Terraces, diversions, and waterways | Irrigation |
| Poor: loamy sand. | Fair for sand. Poor for gravel. | Good if confined. | Good | Nearly level to gently sloping; erodible. | Moderately rapid permeability. | Good to fair compaction characteristics; high piping hazard. | Not applicable. | Moderately rapid permeability; low available water capacity. |
| Poor: loamy sand. | Fair for sand: poorly graded. Poor for gravel: local pockets. | Good | Fair to good | Frequent flooding. | Rapid permeability. | High piping hazard; erodible. | Not applicable. | Rapid permeability; low available water capacity. |
| Fair: clay loam. | Unsuitable | Fair: medium soil support. | Good | Nearly level to strongly sloping. | Moderate permeability. | Fair to good compaction characteristics; stable slopes. | Thickness of material; moderate erodibility; highly calcareous | Thickness of material; moderate permeability; high available water capacity. |
| Good | Poor | Good | Good | Nearly level to gently sloping; erodible. | Rapid permeability. | Good compaction characteristics; high erodibility. | Thickness of material; moderate stability and erodibility. | Thickness of material; high erodibility; rapid permeability. |
| Fair: silty clay loam. | Unsuitable | Poor: low soil support; high plasticity. | Fair: fair shear strength. | Nearly level to sloping; poor workability. | Moderately slow permeability. | Fair to poor compaction characteristics; medium compressibility. | Thickness of material; moderate erodibility. | Thickness of material; moderately slow permeability. |
| Poor: silty clay. | Unsuitable | Poor: low soil support; high plasticity. | Poor: poor shear strength. | Poor workability; subject to ponding; poor internal drainage. | Very slow permeability. | Fair to poor compaction characteristics; high shrink-swell potential. | Not applicable. | Very slow permeability; need for drainage. |
| Good if slope is less than 8 percent; fair if more more than 8. | Poor | Good | Good | Moderately steep; erodible. | Rapid permeability; a few strata of sand. | Good compaction characteristics; high erodibility. | Slopes; moderate stability and erodibility. | Rapid permeability; moderate available water capacity. |
| Poor: loamy sand. | Fair for sand. Unsuitable for gravel. | Good if confined. | Good | Erodible | Rapid permeability. | Good compaction characteristics; unstable slopes; highly erodible. | Not applicable; subject to soil blowing. | Rapid permeability; low available water capacity. |

TABLE 7.—*Interpretations of engineering*

| Soil series and map symbols | Degree and kind of limitation for— | | | | | | | Suitability as source of— |
|---|---|---|---|---|---|---|---|---|
| | Septic tank absorption fields | Sewage lagoons | Shallow excavations | Dwellings | Local roads and streets | Sanitary landfill | | Cover material for sanitary landfill |
| | | | | | | Trench type [1] | Area type | |
| Roxbury: Rx | Slight if protected from flooding. | Moderate if protected from flood- | Slight if protected from flooding. | Moderate with or without base- | Moderate if protected from flood- | Slight if protected from flooding. | Slight if protected from flooding. | Good |

*properties of the soils*—Continued

| Suitability as source of—*Continued* | | | | Soil features affecting— | | | | |
|---|---|---|---|---|---|---|---|---|
| Topsoil | Sand and gravel | Road subgrade [2] | Road fill [2] | Highway location [2] | Pond reservoir areas | Embankments, dikes, and levees | Terraces, diversions, and | Irrigation |

TABLE 8—*Engineering*

[Tests were performed by the State Highway Commission of Kansas under a cooperative agreement with the U.S. Department of Commerce, Officials (AASHTO), except as

| Soil name and location | Parent material | SCS sample No. S-71-Kans— | Depth from surface | Moisture-density data [1] | |
|---|---|---|---|---|---|
| | | | | Maximum dry density | Optimum moisture |
| | | | *In* | *Lb per cu ft* | *Pct* |
| Likes loamy sand: | | | | | |
| 990 feet east and 330 feet north of the center of section 7, T. 35 S., R. 29 W. (Modal) | Colluvial-alluvial material from nearby slopes. | 60-1-1 | 0-9 | 119 | 8 |
| | | 60-1-2 | 9-60 | 111 | 13 |
| Mansic clay loam: | | | | | |
| 1,590 feet east and 510 feet north of the southwest corner of section 7, T. 34 S., R. 28 W. (Modal) | Calcareous loamy High Plains sediment. | 60-3-1 | 0-17 | 112 | 15 |
| | | 60-3-2 | 17-27 | 113 | 15 |
| | | 60-3-3 | 27-72 | 110 | 17 |
| Otero fine sandy loam: | | | | | |
| 1,320 feet north and 330 feet west of the southeast corner of section 7, T. 34 S., R. 28 W. (Nonmodal; surface layer thicker than modal.) | Moderately sandy eolian deposit. | 60-2-1 | 0-12 | 116 | 12 |
| | | 60-2-2 | 12-25 | 120 | 12 |
| | | 60-2-3 | 40-60 | 121 | 10 |
| Roxbury silt loam: | | | | | |
| 350 feet west and 10 feet south of the center of section 11, T. 31 S., R. 27 W. (Modal) | Alluvium | 60-5-1 | 0-19 | 99 | 20 |
| | | 60-5-2 | 19-28 | 103 | 19 |
| | | 60-5-3 | 28-42 | 108 | 16 |
| Spearville silty clay loam: | | | | | |
| 300 feet south and 100 feet east of the northwest corner of section 21, T. 30 S., R. 28 W. (Modal) | Calcareous loess | 60-4-1 | 0-9 | 107 | 18 |
| | | 60-4-2 | 9-20 | 93 | 27 |
| | | 60-4-3 | 40-60 | 105 | 19 |

[1] Based on AASHTO Designation T 99-56, Method A (*1*), with the following variations: (1) all material is ovendried at 230° F; (2) all material is crushed in a laboratory crusher after drying; and (3) no time is allowed for dispersion of moisture after mixing with the soil material.

[2] Mechanical analysis according to AASHTO Designation T 88-57, with the following variations: (1) all material is ovendried at 230° F and crushed

*test data*

Bureau of Public Roads (BPR), in accordance with standard procedures of the American Association of State Highway and Transportation explained in footnotes 1 and 2]

| Mechanical analysis [2] | | | | | | | Liquid limit | Plasticity index | Classification | |
|---|---|---|---|---|---|---|---|---|---|---|
| Percentage less than 3 inches in diameter passing sieve— | | | Percentage smaller than— | | | | | | AASHTO | Unified [3] |
| No. 10 (2.0 mm) | No. 40 (0.42 mm) | No. 200 (0.074 mm) | 0.05 mm | 0.02 mm | 0.005 mm | 0.002 mm | | | | |
| | | | | | | | *Pct* | | | |
| 100 | 88 | 24 | 15 | 6 | 4 | 3 | 20 | 4 | A-2-4(0) | SM, SC |
| 100 | 90 | 10 | 6 | 4 | 4 | 4 | 18 | [4] NP | A-3(0) | SP, SM |
| 100 | 97 | 59 | 48 | 26 | 17 | 14 | 27 | 9 | A-4(5) | CL |
| 100 | 97 | 64 | 53 | 36 | 27 | 23 | 30 | 14 | A-6(7) | CL |
| 100 | 99 | 87 | 79 | 62 | 47 | 39 | 43 | 26 | A-7-6(15) | CL |
| 100 | 96 | 44 | 35 | 19 | 12 | 8 | 23 | 5 | A-4(2) | SM, SC |
| 100 | 95 | 42 | 33 | 23 | 17 | 15 | 22 | 6 | A-4(1) | SM, SC |
| 100 | 92 | 24 | 19 | 16 | 14 | 12 | 19 | 3 | A-2-4(0) | SM |
| 100 | 100 | 90 | 82 | 57 | 35 | 25 | 39 | 15 | A-6(10) | ML, CL |
| 100 | 100 | 92 | 76 | 54 | 34 | 28 | 42 | 23 | A-7-6(14) | CL |
| 100 | 100 | 95 | 84 | 56 | 33 | 27 | 41 | 22 | A-7-6(13) | CL |
| 100 | 100 | 94 | 84 | 54 | 28 | 19 | 31 | 11 | A-6(8) | CL |
| 100 | 100 | 98 | 93 | 75 | 58 | 51 | 66 | 42 | A-7-6(20) | CH |
| 100 | 100 | 96 | 91 | 63 | 36 | 25 | 38 | 19 | A-6(12) | CL |

the fine material is analyzed by the hydrometer method, and the various grain-size fractions are calculated on the basis of all material, including that

that affect mining of the materials, and neither do they indicate quality of the deposit.

Topsoil is used for topdressing an area where vegetation is to be established and maintained. Suitability is affected mainly by ease of working and spreading the soil material, as for preparing a seedbed; natural fertility of the material, or the response of plants when fertilizer is applied; and absence of substances toxic to plants. Texture of the soil ma-

that affect their suitability for camp areas, playgrounds, picnic areas, and paths and trails.

In table 9 the soils are rated as having *slight*, *moderate*, or *severe* limitations for the specified uses. For all of these ratings, it is assumed that a good cover of vegetation can be established and maintained. A limitation of *slight* means that soil properties are generally favorable and limitations are so minor that they can be easily overcome. A *moderate*

TABLE 9.—*Limitations of the soils for recreational development*

| Soil series and map symbols | Camp areas | Picnic areas | Playgrounds | Paths and trails |
|---|---|---|---|---|
| Alluvial land, loamy: An | Severe: flooding | Moderate: flooding | Moderate: flooding | Slight. |
| Blown-out land: Bo | Severe: blowing soils | Severe: blowing soils | Severe: blowing soils | Severe: blowing soils. |
| Campus: Cc<br>For Canlon part, see Canlon series. | Slight | Slight | Moderate: slope is more than 5 percent. | Slight. |
| Canlon<br>Mapped only in complex with Campus soils. | Moderate if slope is less than 15 percent; severe if more than 15 percent: stoniness. | Moderate if slope is less than 15 percent; severe if more than 15 percent: stoniness. | Severe: slope is more than 6 percent in places; depth to rock. | Moderate: stoniness. |
| Harney: | | | | |
| Ha, Hb | Moderate: moderately slow permeability. | Slight | Slight | Slight. |
| Hc | Moderate: silty clay loam | Moderate: silty clay loam | Moderate: silty clay loam; slope is more than 2 percent in places. | Moderate: silty clay loam. |
| Kanza: Kz | Severe: wetness and flooding. | Severe: wetness | Severe: wetness and flooding. | Severe: wetness. |
| Leshara: Le | Severe: wetness | Severe: wetness and flooding. | Severe: wetness and flooding. | Moderate: wetness and flooding. |
| Lesho: Lh | Severe: wetness; clay loam. | Moderate; wetness; clay loam. | Moderate: wetness; clay loam. | Moderate: wetness; clay loam. |
| Likes: Lk | Moderate: loamy sand | Moderate: loamy sand | Moderate: loamy sand | Moderate: loamy sand. |
| Lincoln: Ln | Severe: flooding | Severe: flooding | Severe: flooding | Slight. |
| Mansic: | | | | |
| Ma, Mb, Mc, Mf, Mm<br>For Manter part of Mm, see Manter series. | Moderate: clay loam | Moderate: clay loam | Moderate: clay loam; slope is mostly 2 to 6 percent. | Moderate: clay loam. |
| Mg | Moderate: slope is more than 8 percent in places. | Moderate: clay loam | Severe: slope is more than 6 percent. | Moderate: clay loam. |
| Manter: Mr, Ms, Mt, Mu<br>For Satanta part of Mu, see Satanta series. | Slight | Slight | Slight if slope is less than 2 percent; moderate if more than 2 percent. | Slight. |
| Missler: Mx, Mz | Moderate: silty clay loam | Moderate: silty clay loam | Moderate: silty clay loam; slope is more than 2 percent. | Moderate: silty clay loam. |
| Ness: Ns | Severe: silty clay | Severe: silty clay | Severe: silty clay | Severe: silty clay. |
| Otero: Ot, Ov, Oz | Slight if slope is less than | Slight if slope is less than | Moderate if slope is less | Slight. |

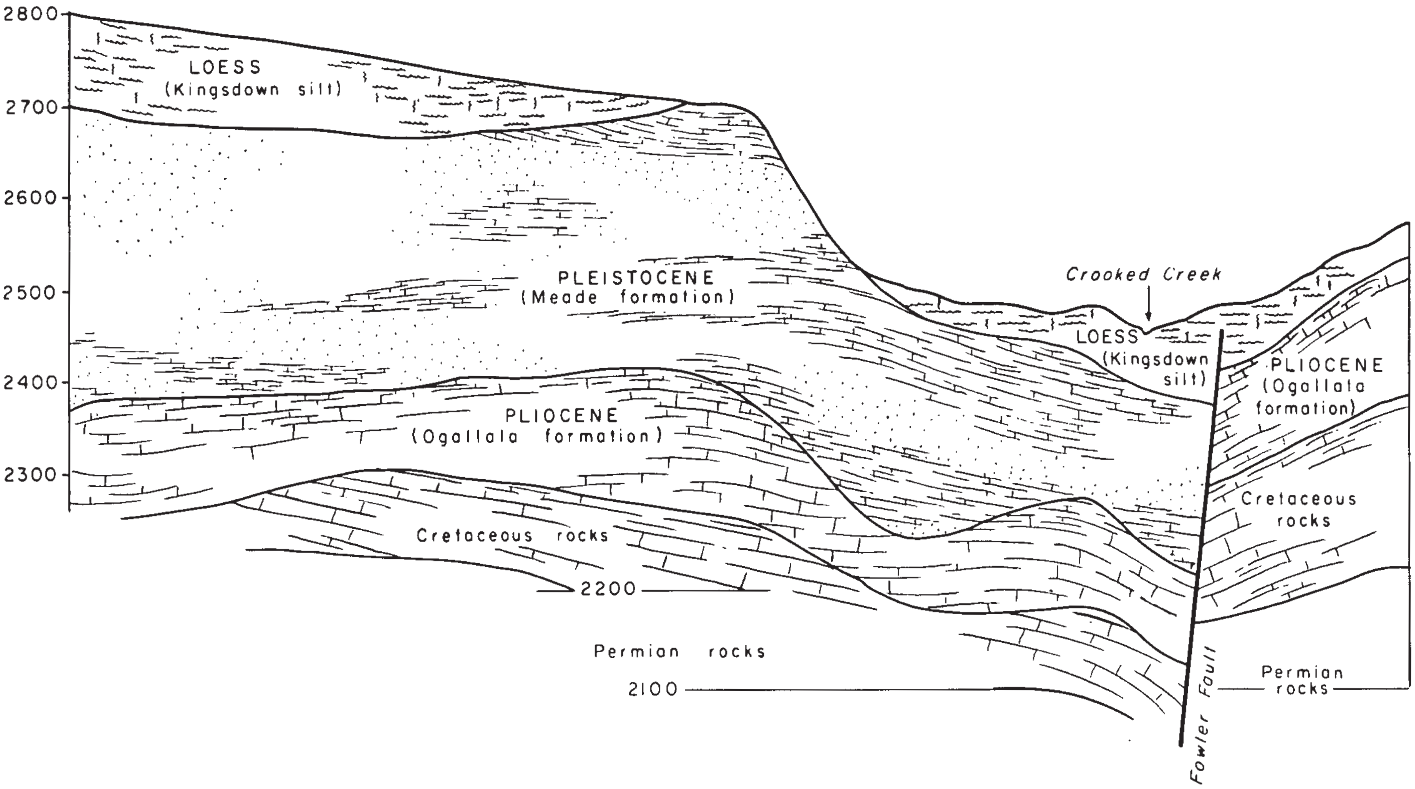



*Figure 27.*—An approximate geologic cross-section through the northern part of the county from east to west along the northern edge of Fowler (7).

lay of the land; and (5) the length of time the forces of soil formation have acted on the soil material.

Climate and plant and animal life, chiefly plants, are active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it to a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material also affects the kind of soil profile that is formed and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent material into a soil profile. It may be much or little, but some time is always required for differentiation of soil horizons. Usually, a long time is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four. Many of the processes of soil development are unknown.

### *Parent material*

The soils of Meade County formed in sediment deposited during the Pleistocene and Recent epochs. The parent material is mainly outwash sediment laid down in the Pleistocene or Late Pliocene epoch (fig. 27).

*Outwash sediments.*—Outwash sediments are the predominant parent material of the sloping to moderately steep soils. These sediments consist of unconsolidated loamy and clayey sediments that are probably of Upper Pliocene age. The deposit contains beds of caliche, and in places these beds are exposed. The material was deposited by widely shifting streams that originated in the Rocky Mountains. Campus, Canlon, and Mansic soils formed in outwash sediments.

Faulting in the Meade Basin followed after the close of the Middle Pliocene sedimentation (*7*). The close of the Pliocene epoch was marked by renewed downwarping. During Early Pleistocene time, the basin and adjacent areas east of the fault were filled by sand, gravel, silt, clay, and volcanic ash. All of these Early Pleistocene deposits make up the Meade Formation. The Mansic-Otero complex is in an area of this geologic material.

*Loess deposits.*—Loess is the predominant parent material of the soils on the High Plains tableland. A loessal deposit of almost grit-free material was deposited as a mantle over the area in the Wisconsin stage of the Pleistocene epoch. The loess on the High Plains is approximately 10 to 45 feet thick. In Meade County, Harney, Spearville, and Uly soils are the dominant soils that formed in loess.

*Alluvial deposits.*—Alluvium of the Recent epoch on the flood plains of the Cimarron River and Sand Creek consists mainly of sand, silt, and gravel. The alluvium along Crooked Creek consists of clay, silt, and sand. Kanza, Lesho, and Lincoln soils formed in recent alluvium on the flood plain of the Cimarron River and Sand Creek. Leshara clay loam is on the flood plain of Crooked Creek, and Roxbury silt loam is on the low stream terrace along Crooked Creek.

*Sandy eolian material.*—Dune sand of Recent age occurs on uplands in the northeastern and southern parts of the county. The sandhills are undulating to hummocky. Tivoli and Pratt soils are the dominant soils that formed in this sandy material.

### *Climate*

Climate affects the physical, chemical, and biological relationships in the soil. The amount of water that percolates through the soil depends partly on rainfall, humidity, and the frost-free period. Water dissolves small amounts of the minerals present and carries them out of the soil. Temperature influences the growth of organisms and affects chemical reaction in the soil.

The climate of Meade County is continental and typical of that in the High Plains. It is characterized by extreme temperatures in summer and winter, by low relative humidity, and by slight to moderate, irregular rainfall.

Because of the limited amount of precipitation in Meade County, soil minerals have not been weathered and leached to any great extent. Few soils have been leached of lime to a depth of more than 30 inches. Except for soils that formed in noncalcareous fine sand, most of the soils have an accumulation of calcium carbonate within 30 inches of the surface.

### *Plant and animal life*

Plant and animal life, both on and in the soil, are active in soil-forming processes. The kinds of plants, animals, and micro-organisms that live on and in the soil are determined by the environment, climate, parent material, relief, and age of the soils. Climate strongly influences soil flora and fauna and, thereby, exerts a strong, indirect influence upon the morphology of the soils.

Organic material is added to the soil as plants die and

### *Time*

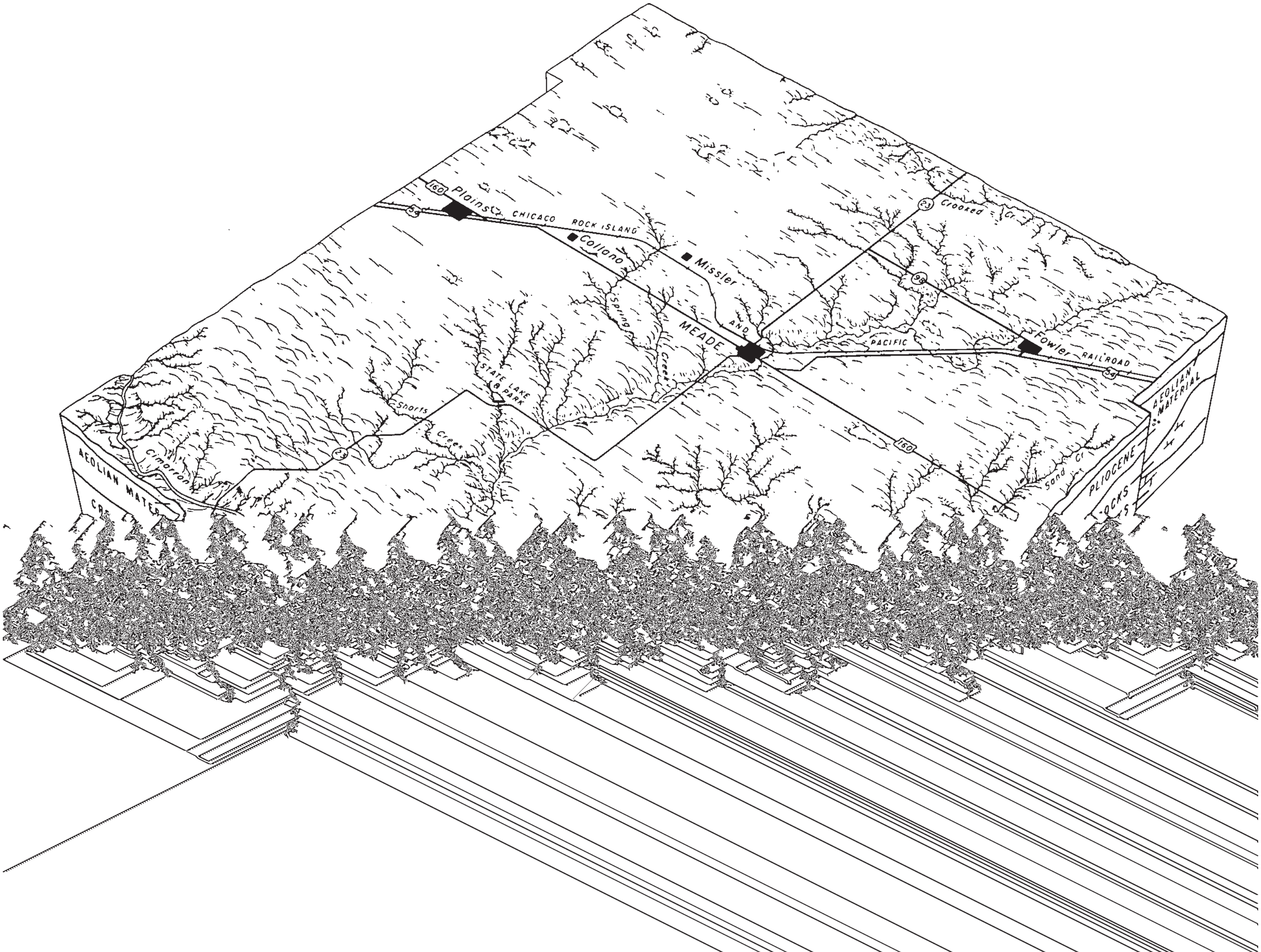
Time is required for soil formation. The length of time needed depends largely on the other factors of soil formation. Soils develop more slowly in Meade County, where the climate is dry and the vegetation is sparse, than they do in areas where the climate is moist and the vegetation dense. As water moves downward through the soil profile, lime and fine particles are gradually leached from the surface layer and deposited in the subsoil. The amount of leaching depends on how much time has elapsed and on the amount of water that penetrates the soil. For example, the Tivoli soils in the sandhills are young soils because they have been stabilized for only a short time and show very little horizon development other than a slight darkening of the surface layer. At the other extreme are such soils as Harney and Spearville soils, which are older, mature soils whose parent material has been in place long enough so that they have a well-developed profile.

## Classification of Soils

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help us to understand their behavior and their response to manipulation. First through classification and then through use of soil maps, we can apply our knowledge of soils to specific fields and other

TABLE 10.—*Soil series classified according to the current system*

| Series | Family | Subgroup | Order |
|---|---|---|---|
| Campus | Fine-loamy, mixed, mesic | Typic Calciustolls | Mollisols. |
| Canlon | Loamy, mixed (calcareous), mesic | Lithic Ustorthents | Entisols. |
| Harney [1] | Fine, montmorillonitic, mesic | Typic Argiustolls | Mollisols. |
| Kanza | Mixed, thermic | Mollic Psammaquents | Entisols. |
| Leshara [2] | Fine-silty, mixed, mesic | Typic Haplaquolls | Mollisols. |
| Lesho | Fine-loamy over sandy or sandy-skeletal, mixed, thermic. | Fluvaquentic Haplustolls | Mollisols. |
| Likes | Mixed, thermic | Typic Ustipsamments | Entisols. |
| Lincoln | Sandy, mixed, thermic | Typic Ustifluvents | Entisols. |
| Mansic | Fine-loamy, mixed, thermic | Aridic Calciustolls | Mollisols. |
| Manter | Coarse-loamy, mixed, mesic | Aridic Argiustolls | Mollisols. |
| Missler | Fine, mixed, thermic | Typic Haplustolls | Mollisols. |
| Ness | Fine, montmorillonitic, mesic | Udic Pellusterts | Vertisols. |
| Otero | Coarse-loamy, mixed (calcareous), mesic | Ustic Torriorthents | Entisols. |
| Pratt | Sandy, mixed, thermic | Psammentic Haplustalfs | Alfisols. |
| Roxbury | Fine-silty, mixed, mesic | Cumulic Haplustolls | Mollisols. |


Plains
CHICAGO ROCK ISLAND
Collano
Missler
MEADE
AND
PACIFIC
Fowler
RAILROAD
Crooked Cr
Spring Creek
STATE LAKE & PARK
Shorts Creek
Cimarron
Sand Cr
AEOLIAN MATER
AEOLIAN MATERIAL
PLIOCENE

have been constructed across intermittent drainageways in the uplands, but most ranchers must rely upon wells for stockwater during at least part of the year. Irrigation water is pumped from deep wells drilled into the Ogallala Formation. Water is relatively abundant in some areas, but it is limited or absent in others.

The sands and gravels of the Ogallala Formation are the most productive source of ground water in the county. The sands and gravels of the Meade Formation rank next to the Ogallala Formation as a water-bearing formation in Meade County.

## Climate [8]

Meade County has a typical continental climate, as would

low and not sufficient to produce substantial precipitation. Most of the moisture that reaches this area must come from the Gulf of Mexico (*4*); however, the general circulation pattern of the atmosphere allows movement in this direction only occasionally.

Climatological records have not been made continuously at one location in Meade County for a long period of time. Early records were made at Plains, but they ceased in the late 1940's. Since then records have been kept at Meade and at Fowler. Because it is necessary to have at least 30 years of record to determine the reliable climatic data, the records from Ashland in nearby Clark County are shown in table 11; these should be representative of Meade County. The values for precipitation might be slightly lower than those presented; but it would amount to no more than 1

Snowfall is light in most years. The average for the county is about 15 inches. Winter cyclones moving from their origin in the northeastern part of New Mexico pass nearby. Such storms can bring blizzard conditions, but they are infrequent. Snow seldom remains on the ground for much more than 2 or 3 days.

The large daily variations in temperature are the result of high altitude and low humidity, both of which allow marked heating by solar radiation during the day and large losses of heat from the ground at night. The daytime temperature averages 25 to 30 degrees higher than the nighttime temperature. It is not unusual for diurnal ranges of temperature to reach 40 degrees.

The annual range in temperature is also large. Annual extremes generally range from near zero to more than 100 degrees. These extreme spells are generally of short duration and are not of great importance to the overall climate. Table 11 shows the monthly average temperatures at Ashland, from which it can be seen that the transitional sea-

## Farming

Before the 1880's, all of Meade County was used for raising cattle. During the latter part of the nineteenth century, there was rapid settlement of the area by farmers. The population of the county has fluctuated over the years. It has decreased rapidly during prolonged droughts, but surged upward again as new settlers arrived during times of adequate rainfall to produce crops.

After the droughts and dust storms of the 1930's as a result of low rainfall, the first large irrigation well was constructed on the upland in 1939. Some acreages in the Artesian Valley were also irrigated with existing flowing wells. The U.S. Census of Agriculture reported that in 1969 about 50,000 acres in the county was irrigated.

Dryland farming and irrigated farming are both practiced in Meade County. The raising of livestock has increased in the last 20 years. Ranchers are mainly confined to the sloping and strongly sloping land along the Cimarron head of cattle. Hundreds of other cattle are finished out at smaller feedyards. There are only a few herds of dairy cattle in the county. According to the 1969 U.S. Census of Agriculture, there were about 305 milk cows, 53,478 other cattle, 5,330 hogs and pigs, 4,175 sheep and lambs, and 10,527 chickens in the county.

## Natural Resources, Transportation, and Markets

Soil and ground water are important natural resources in Meade County. Gas, oil, sand, gravel, and volcanic ash are other natural resources in the county. The sand and gravel

**Available water capacity** (also termed available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

**Calcareous soil.** A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

**Caliche.** A more or less cemented deposit of calcium carbonate in many soils of warm-temperate areas, as in the Southwestern States. The material may consist of soft, thin layers in the soil or of hard, thick beds just beneath the solum, or it may be exposed at the surface by erosion.

**Chlorosis.** Yellowing or blanching of green portions of a plant, particularly the leaves. May be caused by disease organisms, unavailability of nutrients, or other factors.

**Clay.** As a soil separate, the mineral soil particles less than 0.002 milli-

**Leached soil.** A soil from which most of the soluble materials have been removed from the entire profile or have been removed from one part of the profile and have accumulated in another part.

**Loam.** As a soil textural class, a soil material that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand.

**Loess.** Fine-grained material, dominantly of silt-sized particles, that has been deposited by wind.

**Parent material.** Disintegrated and partly weathered rock from which soil has formed.

**Permeability.** The quality that enables the soil to transmit water or air. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

**pH value.** A numerical means for designating acidity and alkalinity in soils. A pH value of 7.0 indicates precise neutrality; a higher value, alkalinity; and a lower value, acidity.

**Profile, soil.** A vertical section of the soil through all its horizons and extending into the parent material.

**Reaction, soil.** The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

| | *pH* | | *pH* |
|---|---|---|---|
| Extremely acid | Below 4.5 | Neutral | 6.6 to 7.3 |
| Very strongly acid | 4.5 to 5.0 | Mildly alkaline | 7.4 to 7.8 |
| Strongly acid | 5.1 to 5.5 | Moderately alkaline | 7.9 to 8.4 |
| Medium acid | 5.6 to 6.0 | Strongly alkaline | 8.5 to 9.0 |
| Slightly acid | 6.1 to 6.5 | Very strongly alkaline | 9.1 and higher. |

**Relief.** The elevations or inequalities of a land surface, considered collectively.

**Saline soil.** A soil that contains soluble salts in amounts that impair growth of plants but that does not contain excess exchangeable sodium.

**Sand.** Individual rock or mineral fragments in a soil that range in diameter from 0.05 to 2.0 millimeters.

**Silt.** Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

**Soil.** A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

**Solum.** The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

**Structure, soil.** The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are either *single grained* (each gran by itself, as in dune sand) or *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

**Subsoil.** Technically, the B horizon; roughly, the part of the solum below plow depth.

**Substratum.** Technically, the part of the soil below the solum.

**Surface soil.** The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

**Terrace** (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

**Texture, soil.** The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt*

# GUIDE TO MAPPING UNITS

For a complete description of a mapping unit, read both the description of the mapping unit and the description of the soil series to which the mapping unit belongs. Dashed lines indicate soil is not irrigated or is not placed in a range site or windbreak suitability group.

| Map symbol | Mapping unit | Page | Capability unit: Dryland Symbol | Capability unit: Irrigated Symbol | Range site: Name | Range site: Page | Windbreak suitability group: Name |
|---|---|---|---|---|---|---|---|
| An | Alluvial land, loamy------------------------ | 7 | VIw-1 | ------ | Loamy Lowland | 33 | Lowland |
| Bo | Blown-out land------------------------------ | 7 | VIIe-1 | ------ | Choppy Sands | 35 | |

GUIDE TO MAPPING UNITS--Continued

| Map symbol | Mapping unit | Page | Capability unit Dryland Symbol | Capability unit Irrigated Symbol | Range site Name | Range site Page | Windbreak suitability group Name |
|---|---|---|---|---|---|---|---|
| Sb | Satanta loam, 0 to 1 percent slopes---------- | 21 | IIc-1 | I-1 | Loamy Upland | 33 | Silty Upland |
| Sc | Satanta loam, 1 to 3 percent slopes---------- | 21 | IIe-1 | IIe-1 | Loamy Upland | 33 | Silty Upland |
| Sp | Spearville silty clay loam, 0 to 1 percent slopes------------------------------------ | 22 | IIs-2 | IIs-2 | Clay Upland | 33 | Silty Upland |
| Tv | Tivoli fine sand, 10 to 25 percent slopes--- | 23 | VIIe-1 | ------ | Choppy Sands | 35 | ------------ |
| Ua | Uly silt loam, 0 to 1 percent slopes-------- | 24 | IIc-1 | I-1 | Loamy Upland | 33 | Silty Upland |
| Ub | Uly silt loam, 1 to 3 percent slopes-------- | 25 | IIe-3 | IIe-3 | Loamy Upland | 33 | Silty Upland |
| Uc | Uly silt loam, 1 to 3 percent slopes, eroded------------------------------------ | 25 | IIIe-1 | IIe-3 | Limy Upland | 33 | Silty Upland |
| Us | Uly silt loam, 3 to 6 percent slopes-------- | 25 | IIIe-1 | IIIe-1 | Loamy Upland | 33 | Silty Upland |
| Ut | Uly silt loam, 3 to 6 percent slopes, eroded------------------------------------ | 26 | IVe-2 | IIIe-1 | Limy Upland | 33 | Silty Upland |
| Wn | Wann loam------------------------------------ | 27 | IIw-2 | IIw-2 | Subirrigated | 36 | Subirrigated Lowland |
| Yo | Yahola sandy loam---------------------------- | 28 | IIIe-4 | IIs-1 | Sandy Terrace | 35 | Sandy Upland |

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